The Economic Value of the Coral Reefs of Saipan, Commonwealth of the Northern Mariana Islands

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Abbreviations

Abbreviation		*Definition*
ACOE	=	US Army Corps of Engineers
BNMP	=	Bonaire National Marine Park
CBA	=	Cost Benefit Analysis
CDM	=	Clean Development Mechanism
CEEC	=	Cesar Environmental Economics Consulting
CMRO	=	Coastal Resources Management Office
CNMI	=	Commonwealth of the Northern Mariana Islands
CPUE	=	Catch Per Unit Effort
CRM	=	CNMI Coastal Resources Management Office
CVM	=	Contingent Valuation Method
DCE	=	Discrete Choice Experiment
DEQ	=	CNMI Division of Environmental Quality
DFW	=	CNMI Division of Fish and Wildlife
DLNR	=	CNMI Department of Lands and Natural Resources
EPA	=	US Environmental Protection agency
ESRI	=	Environmental Systems Research Institute, Inc.
FPE	=	Foundation of the Philippine Environment
FY	=	Fiscal Year
GEF	=	Global Environment Fund
GIS	=	Geographical Information System
IDB	=	Inter-American Development Bank
KNP	=	Komodo National Park
LAS	=	Three-Year Coral Reef Protection Local Action Strategy
MARC	=	Micronesian Area Research Center
MMA	=	Marine Managed Area
MPA	=	Marine Protected Area
MPLA	=	Marianas Public Lands Authority
MRFM	=	MesoAmerican Barrier Reef System
MVA	=	Marianas Visitors Authority
N/A	=	Not Applicable
NFWF	=	National Fish and Wildlife Foundation
NGO	=	Non-Governmental Organization
NM	=	Nautical Mile
NMFS	=	US National Marine Fisheries Service
NOAA	=	National Oceanic and Atmospheric Administration
NPS	=	US National Park Service
NPV	=	Net Present Value
SPREP	=	South Pacific Regional Environmental Program
SWFC	=	Fishery Statistics of the Western Pacific
TCA	=	Travel Cost Approach
TEV	=	Total Economic Value
TNC	=	The Nature Conservancy
USCRI	=	United States Coastal Reef Initiative
USFWS	=	US Fish and Wildlife Service
VAT	=	Value-added tax
WTP	=	Willingness to Pay
WTTC	=	World Travel and Tourism Council
WWF	=	World Wide Fund for Nature

Executive Summary

Saipan's beautiful fringing and barrier coral reefs are scattered along the 68 km coastline. The economic importance of this ecosystem is significant. Besides providing food, shelter and cultural significance for the citizens on Saipan, the coral reefs generate revenue from tourists and recreational users attracted by the beauty of the coral and its inhabitants. The main objective of the study was to carry out an economic valuation of the coral reefs and associated resources on Saipan. The results of the study were derived through five major research methodologies:

1. Household survey
2. Discrete choice experiment
3. Total Economic Value Calculation
4. Spatial analysis
5. Sustainable financing

Household survey: The main purpose of the household survey (of 375 local residents) was to determine the nature and level of the use and non-use values of coral reefs, from the perspectives of local communities on Saipan. The survey covered a number of issues, such as respondents' level of beach and marine recreation, environmental awareness, fishing activities and the importance of fish in their diet. The survey showed that the residents of Saipan are still strongly connected to the coral reefs and the ocean. Citizens of Saipan still heavily use the marine environment surrounding the island for fishing and recreational activities. As such, people are strongly concerned about further deterioration of the marine environment on Saipan and support policy interventions by the CNMI government to reverse this negative trend. The most important threat perceived by the residents of Saipan, by far, is water pollution caused by runoff and sewage operations (see Figure E.1). Therefore, in the opinion of the respondents, the repair and extension of the sewage outfalls and the reduction of runoff have priority. This encouraging finding of the survey is an important support for policy makers in the CNMI that aim to expand environmental measures in the field of coral reef management.

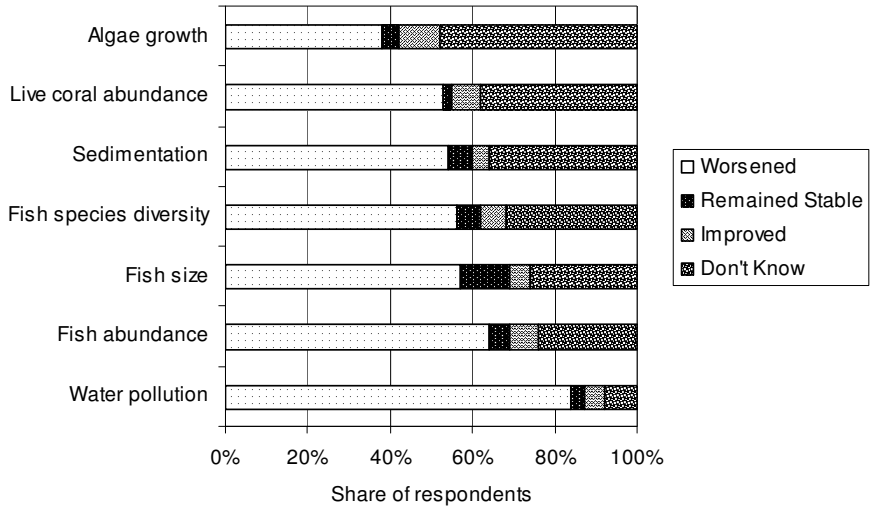

Figure E.1 Perception of changes on Saipan's marine environment

Discrete choice experiment: To estimate the economic value of the above-mentioned non-market values, the Discrete Choice Experiment (DCE) was used. In the DCE, respondents were presented with a series of choice sets, composed of different attributes associated with reefs and their management (e.g. recreation, fisheries, tax payments). They were then asked to choose between these choice sets. Saipan's residents appeared to place a similar value on the ability of reefs to provide local recreational benefits and supply culturally significant fish species. Although there is some indication that Saipan's residents may support increasing the size of the MPA in the lagoon, they are much more concerned with the effects of pollution and managing pollution as a threat to the reefs. They are generally willing to pay more tax for this issue to be addressed.

Total Economic Value: At the core of the economic value of coral reefs on Saipan are the various ecosystem functions associated with these marine systems. These, in turn, translate into reef-associated goods and services used by Saipan's (e.g. tourism, fisheries). The sum of these values forms the Total Economic Value (TEV), representing the entire economic importance of Saipan's marine environment, which was estimated at $61.16 million per year. Market values make up 73% of the TEV, while the remaining 27% consist of non-market values. Due to uncertainties in the data and the analysis, the TEV may vary between $42 million and $76 million per year. With an annual value of $42.31 million, the tourism industry is by far the greatest beneficiary of the services provided by coral reefs on Saipan (see Figure E.2). This economic importance is not reflected in the funds made available by the CNMI Government to manage the reefs.

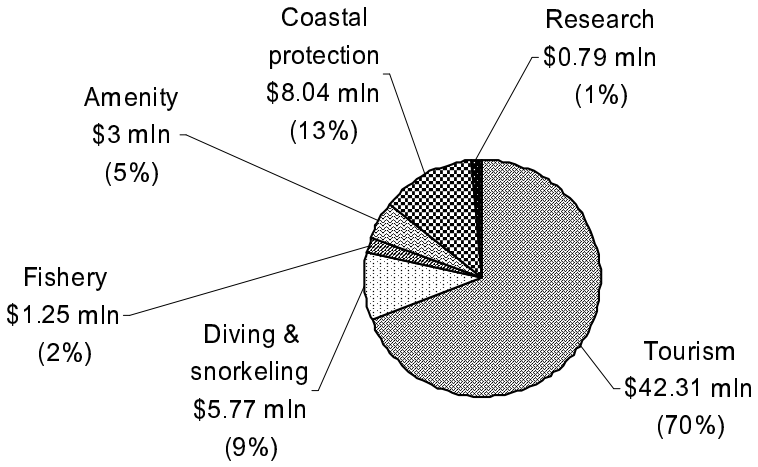

Figure E.2 Total Economic Value of coral reefs on Saipan (in million US$)

Spatial analysis: The spatial dimension of interactions between the economy and coral reef is crucial in understanding their economic value. Generally, the beneficiaries of the reefs' goods and services are not spread evenly throughout Saipan, but vary from location to location. Therefore, Geographic Information System (GIS) tools were used to increase our understanding of this spatial variation in economic values. This helped us to recommend policy interventions more effectively. Although the average value of reefs per square kilometer amounted to $0.8 million, the highest value per square kilometer was around $9 million. This highest value category is predominantly comprised of the most popular diving and snorkeling sites. Having compared the distribution of reefs' total economic value and their anthropogenic threats, we conclude that, in general, the more valuable the reef, the poorer their condition and the greater their threats.

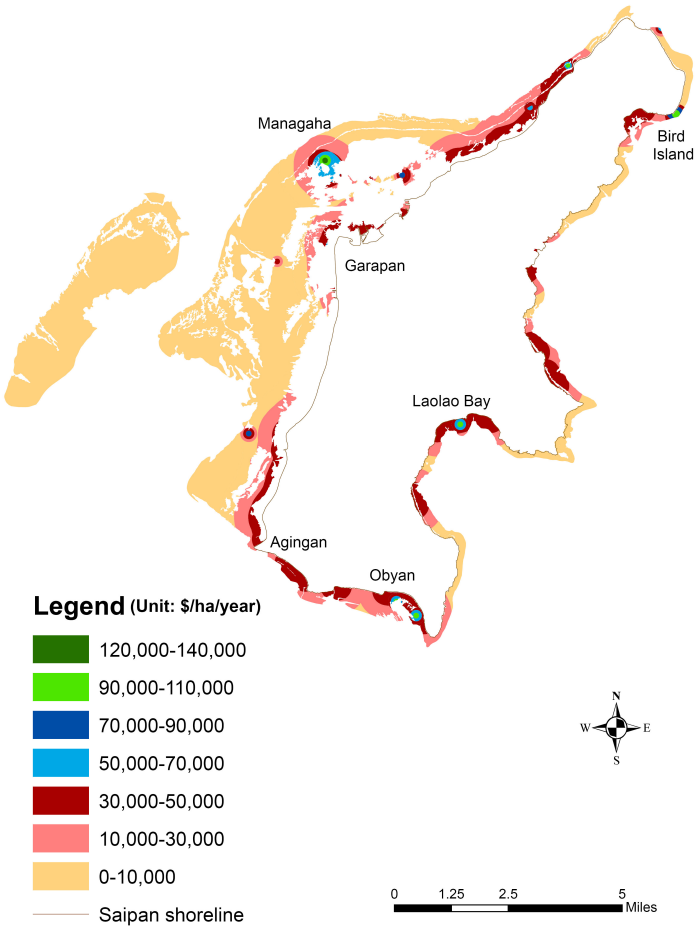

Figure E.3 Total economic value of coral reefs on Saipan (in $/km^2/year)

Sustainable financing: Governments need to recognize and accept that conservation and economic development are inextricably linked. Therefore, it is important to increase the financial flows to environmentally sustainable activities in general and to protected areas in particular. Throughout the world, governments are increasingly cooperating with NGOs, the private sector and local communities to finance ecologically valuable areas. To investigate this concept of sustainable financing of coral reef management on Saipan, a qualitative assessment was made of the various instruments applied in MPAs around the world. Because user fees as a revenue-raising tool are suited to Saipan conditions, special emphasis in the assessment was put on the implementation or expansion of this financial instrument. Three sites were considered in particular: (1) Managaha Island, (2) Laolao Bay and (3) the Grotto.

Policy recommendations: Saipan's Local Action Strategy (LAS) gives a good idea of the type of management interventions planned in the CNMI. By combining the LAS (2003) and the findings of the valuation study, several specific policy recommendations can be provided. These include:

1. Tackle the problem of non-point and point source pollution;
2. Make use of the cultural importance residents place on marine ecosystems to improve coral reef management;
3. Develop a comprehensive system of user fees for visitors of the Marine Protected Areas on Saipan.

1. Introduction

1.1 Background

The Mariana Islands developed west of the Mariana Trench along the edge of the Philippine Plate and consist of both active and dormant volcanoes. This island arc chain comprises a total of 15 islands and is politically separated into two groups; the U.S. Territory of Guam and the Commonwealth of the Northern Mariana Islands (CNMI). The 14 islands that comprise the CNMI extend approximately 400 nm from Rota (14^0 Latitude) northward to Uracas (20^0 Latitude). These islands are geologically divided into two distinct types; the older arc islands are characterized as raised limestone islands while the more recent and younger arc islands are still volcanically active. The older islands, Rota, Aguijan, Tinian, Saipan, and Farallon de Medinilla have fringing and/or barrier reef systems. In contrast, the volcanically active arc islands have relatively little coral reef development. All islands north of Esmeralda Bank (i.e., Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug and Farallon de Pajaros or Uracas) are classified as 'recent' by Eldredge (1983).

The 2000 census identified over 99.9% of the total CNMI population living on the three southern islands of Rota, Tinian and Saipan. The largest island, Saipan, is approximately 46.5 square miles in size, and supports 90% of the population with the remaining 10% of the residents split evenly between Tinian and Rota. Garment manufacturing and tourism are the two primary industries that support the CNMI economy. Tourism is most dependent upon the island's tropical natural resources, such as coral reefs and clear ocean waters, in addition to other leisurely activities offered on the island (e.g., golfing, shopping and marine recreational activities). It is also believed to be the industry of choice by many of the island residents.

Tourists come primarily to Saipan from the following countries (in decreasing order of importance using 2002 data); Japan, Korea, USA (includes Guam), Peoples Republic of China, and Hong Kong/Taiwan. Tourist arrival statistics from MVA show a steady increase in arrivals from 505, 295 in 1992 to a high of 736,117 during 1996. A sharp decline in arrivals during 1997 and 1998 had a negative impact on both the tourist industry and island economy. Despite a slight increase to a maximum of 501,788 during 1999, a further two years of decline led to the lowest arrival figures since 1992 of 444,284 during 2001. However, arrival figures then increased slightly during 2002 and are now believed to be steadily increasing today. With a focus on ensuring the future of the CNMI's tourist industry, it has now become essential to understand the economic value and underlying public perception of those natural resources that support the tourism industry; namely coral reefs and water based recreational activities.

In a regional coral reef overview, NOAA (2004) estimated that the CNMI contained a total of 45 km^2 of nearshore reef areas; defined as being located within a 3 nm radius of land forms. For purposes of the review, reef areas were defined as hard bottom substrates lying adjacent to coastlines, or shoal areas, which are shallower than 100 m in depth. Obviously most of the nearshore reef areas are submerged extensions of the island landform, with the possible exception of Tatsumi Reef, which is located off the southern tip of Tinian.

Of the inhabited islands in the CNMI, Rota and Tinian have fringing reefs with Rota having the more developed reef system. Saipan, on the other hand, has a gently sloping western coastline containing a lagoon/barrier reef system with fringing reefs in a number of localities along the windward, or eastern coastline.

Saipan Lagoon and it's surrounding area is the focus of this study. It is approximately 11.9 square miles in size and parallels virtually the entire western coastline. At it furthest point, the barrier reef lies 2 miles from shore. Saipan Lagoon is used for fishing, water sports, swimming, diving and as a general drawing point for both island residents and tourists. It also is the recipient of a sewer outfall from the Sadog Tasi Wastewater Treatment Plant, receiving waters from stormwater drainage systems, and contains the commercial port facilities.

Threats to Saipan's coral reef systems are many and grew due to the expansion in its large resident population base and tourist industry. Possibly the greatest threat is the surface upland runoff that ends up in the lagoon system, where current dynamics are relatively more static then along the windward coastline. Runoff can contain sediment, oil and other organics, fertilizers, pesticides, and a host of other toxics and hazardeous materials that are found commonly on the island. Heavy rains can create conditions where many of these substances enter the marine environment and have a potentially detrimental impact to benthic stationary biological resources, such as corals and marine plant life.

Though actual detailed impacts are not clear, it is believed that the Sadog Tasi Wastewater Treatment Plant outfall is influencing nutrient levels in portions of the Saipan Lagoon. Other threats, such as anchor damage, overuse of resources by tourists, destructive fishing practices, and unmanaged consumptive use of marine resources, all contribute to the general decline in the "quality" of a marine ecosystem. Coupled with naturally occurring events such as periodic bleaching episodes, coral disease, typhoons, and occasional outbreaks of the crown-of-thorns starfish, Saipan's coral reefs have a potentially endless array of threats attacking every facet of their existence.

In February 1983, the Coastal Resources Management Office (CRMO) was created to promote the conservation and sustainable development of the CNMI's coastal zone with a Lagoon and Reef Area of Particular Concern regulations and permitting process. Twenty years later, in September 2003, CNMI agencies and stakeholders prepared the "Three-Year Coral Reef Protection Local Action Strategy (LAS)", in which several projects focused on developing a sustainable long-term marine use program. Due to the lack of knowledge on the exact economic value of the coral reefs in the CNMI, the economic benefits of these individual projects have not been determined. This makes it more difficult to prioritize and justify investments in coral reef management and conservation.

Economic valuation provides an instrument for policy makers on Saipan to use for deciding the level of protection and conservation needed for those reefs. In other words, policy makers can work out whether the benefits of coral reef management exceed the costs of these interventions. The LAS (2003) refers to this as "to concretize the economic justifications for protecting the health and extent of CNMI coral reef ecosystems". It is also important to note that economic valuation helps to communicate the importance of coral reefs. Additionally, it provides baseline information on the status of the benefits of

those reefs, such as past and current coral reef fisheries, fish stocks and fishing effort, and measure the true costs of current impacts of proposed developments in the coastal zone. Finally, the valuation of the coral reef is a means to leverage additional support for coral reef protection priorities as also described in the LAS (2003).

1.2 The study

The main objective of the study is to carry out an economic valuation of the coral reefs and associated resources on Saipan. The focus is on valuing the six main uses/users of selected coral reef areas on Saipan: (i) fishing; (ii) recreational uses (iii) tourism uses; (iv) shoreline protection; (v) amenity values; and (vi) biodiversity. This study will arrive at a set of economic values in gross terms for each of the six main reef uses for Saipan.

Besides addressing the Total Economic Value (TEV) of Saipan's coral reefs in general, two extensions of the study aim to demonstrate the practical use of economic valuation for the management and protection of the marine environment on Saipan. Firstly, Geographic Information System (GIS) analysis is conducted in order to show the spatial variation of the TEV across the various reef locations. This in turn assists in the process of prioritization of different management option at various locations. Secondly, the study will suggest financing measures that take into account the true value of coral reefs to the CNMI. Such financial flows can subsequently be utilized for managing coral reefs.

Figure 1.1 shows the methodological approach followed in this study to estimate the economic values of the individual benefit categories, and subsequently the Total Economic Value (TEV) of coral reefs on Saipan. The estimation of the value of each benefit required specific data inputs. Although a number of secondary data sources were used for this purpose, the most important source of data is the household survey. This provided high quality primary data for the economic analysis. The data collection and valuation procedures are explained in detail in the coming Chapters. Figure 1.1 also shows the methodological extensions for GIS, CBA and Sustainable Financing.

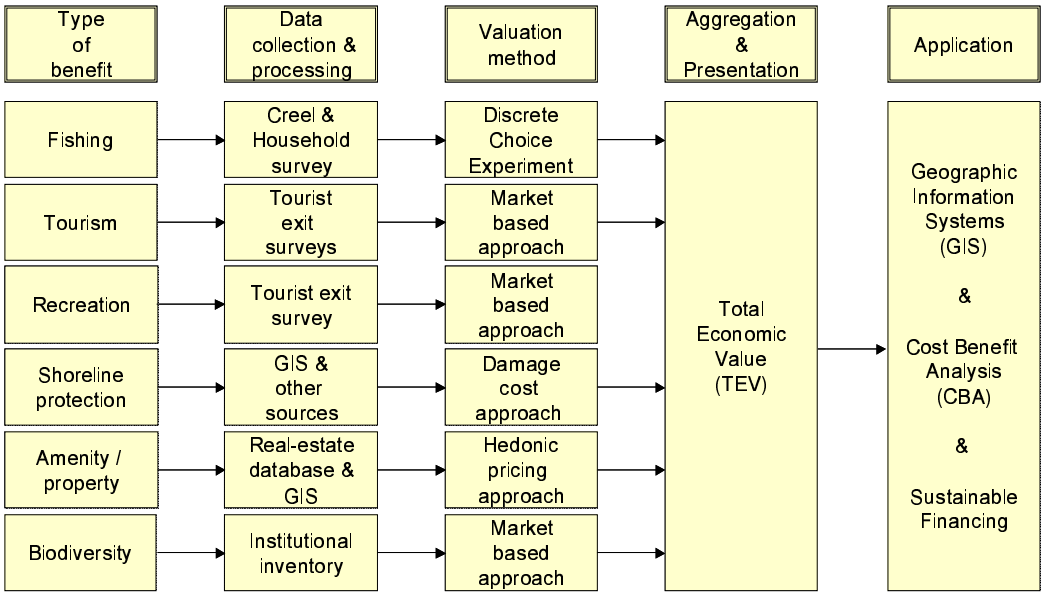

Figure 1.1 Methodological approach of the study

1.3 Structure of the report

The report is structured as follows: Chapter 2 provides a detailed explanation of the results of the household survey. Key issues are highlighted, such as the residents' habits with regard to recreation and fishing. Chapter 3 presents the outcome of the discrete choice experiment, in which the non-use values of coral reefs on Saipan are estimated. The tourist exit survey is discussed in Chapter 4 and compared with existing surveys. Special attention is given to the issue of retention in the tourist industry. The Total Economic Value (TEV) is determined in Chapter 5. This is the cumulative value of several distinct sub-categories, including: fisheries, tourism, diving and snorkeling, biodiversity, amenity, and coastal protection. Maps demonstrate the spatial variation of the TEV with the help of GIS in Chapter 6. Chapter 7 presents an overview of sustainable financing mechanisms and elaborates on user fee systems, and some indicators are given to determine the sustainability of the financing of the three MPAs. Finally, conclusions and discussions are presented in Chapter 8. The report contains a number of Appendices containing background materials linked with primary data collection methods , such as the household survey, the fishery survey, the choice experiment, financing mechanisms and user fee systems.

2. Household survey results

2.1 Introduction

Marine-related resources play a crucial role in the lives of citizens of the CNMI. The strong fishing tradition and the habit of barbequing on the beach provide the basis for a clear bond between the ocean and the people of Saipan. Because this relationship has been predominantly built upon tradition, folklore and leisure rather than on financial or subsistence motives, this link is labeled as a 'cultural value'.

To determine the nature and the level of the cultural value of coral reefs on Saipan, a survey based on 'choice modeling' was conducted. The survey solicited information about the cultural and ethnic background, age, gender, education and income of the interviewee. This allowed for an analysis of differences in values across different ethnic groups and socio-economic backgrounds. The demographics of the respondent together with other questions gave an insight into how these values are shaped, and how and why perceptions change over time. This survey-based approach was supplemented with key informant interviews and focus group discussions to get a better understanding of the cultural/traditional/non-use values of coral reefs and of trends over time.

From March to September 2005, 375 inhabitants of Saipan were interviewed about their relationship with and perception of the island's marine environment. The composition of the sample included the main ethnic and socio-economic groups on Saipan. The ethnic selection was based upon the residential areas of different groups Special efforts were made to include seaside communities in the sample. Each village was represented in the survey effort to accomplish a more general geographical coverage.[1] Within the neighborhoods, streets were randomly selected for surveying. Within each selected street, every third house was approached. If the selected household did not want to be involved, the house right next door was approached. The average length of an interview was around 50 minutes to one hour.

The questionnaire had several different sections (see Appendix I and II). Part 1 of the questionnaire addressed general issues, including recreation, environmental awareness and the importance of fish in interviewees' diets. Part 2 of the survey was specifically focused on fishing and was therefore only completed by fishermen. Part 3 involved the choice experiment and required specific guidance by the interviewer. Finally, Part 4 consisted of closing questions regarding marine resource management as well as the demographics of the respondent.

The main results of the survey are summarized in the following sections.

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[1] In total 400 households have been interviewed. 60 from Capital Hill, Garapan, San Vicente, Kobelerville, and Chalan Kanoa. 20 from Tanapag, Kagman, San Antonio, San Roque, San Jose.

2.2 Profile respondent

The analysis of the demographic section, other than simply providing a set of useful statistical information about the sample, gives a more accurate picture of the multi-national and multi-ethnic profile of Saipan's society. The presence on the island of a large community originally from the Philippines is adequately represented within the sample. As shown in Table 2.2, the share of immigrants from the Philippines (30%) is almost equivalent to the percentage of respondents born on Saipan (40%). Immigrants from other countries are represented in the remaining 30% of the sample.[2] Because Chinese immigrants have very little interaction with coral reefs and because they generally remain only temporarily on Saipan, this group was not represented to the full 22.5% present on the island.

Table 2.1 Country of origin

Rank	Country of Origin	Number respondents – survey		Number people – census 2000	
		#	%	#	%
1	Saipan/Rota/Tinian	149	40.1%	30,391	43.9%
2	Philippines	110	29.6%	15,701	22.7%
3	Fed. States of Micronesia	34	9.2%	2,094	3.0%
	- Chuuk	*17*	*4.6%*		
	- Yap	*8*	*2.2%*		
	- Pohnpei	*6*	*1.6%*		
	- Kosrae	*3*	*0.8%*		
4	Palau	23	6.2%	1,244	1.8%
5	China	13	3%	15,583	22.5%
6	Guam	8	2.2%	-	-
7	Mainland US	6	1.6%	54	0.1%
8	Korea	6	1.6%	1,797	2.6%
9	Elsewhere	23	6.2%	2,357	3.4%

Source: CNMI 2000 Census

In line with the actual ethnic composition of Saipan's population, Filipino and Chamorro respondents together represent more than half of the survey sample. The third most important ethnic group is Carolinian (18.4%). A detailed breakdown of the sample according to the ethnic background is provided in Table 2.2. Due to incomplete data on ethnicity in the 2000 census, a comparison with the actual ethnic composition on Saipan is not feasible.

The great majority of the respondents, immigrants included, have long-term expectations about their lives on Saipan. Overall, 63% of the entire sample expects to live on Saipan for the rest of their life or at least 25 more years. Conversely, a much lower percentage of the interviewees intend to leave Saipan in the coming 5 years (22%) or within a year (6%). We must assume that respondents' future expectations are based upon their present working and living conditions.

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[2] As far as immigration is concerned, survey results confirm that Saipan experienced the highest immigration flows during the 1980's (22%) and in the 90's (50%).

Table 2.2 Ethinc Background

Rank	Ethnic origin and race	Number respondents	
		#	%
1	Filipino	113	30.2%
2	Chamorro	91	24.3%
3	Carolinian	69	18.4%
4	Palauan	24	6.4%
5	Chuukese	18	4.8%
6	Chinese	13	3.5%
7	Yapese	7	1.9%
8	Pohnpeian	5	1.3%
9	Korean	5	1.3%
10	Kosraen	4	1.1%
11	Caucasian	3	0.8%
12	Other	22	5.9%

According to the official statistics, Saipan's economy is largely based on the tourism, construction, and garment industries (US-CIA, 2005). In terms of the number of employees per occupation, the major slice of the workforce (48%) consists of operators, fabricators and laborers. 16% of the labor force is involved in managerial and professional activities, 14% in technical, sales and administrative occupations, 13% in services, 8% in production or handicrafts and only 1% of the active population is employed in farming, forestry and fishing (2003 CNMI American Community Survey).

Table 2.3 summarizes the survey results on the professional background of the respondents. As evidenced by the percentages, the sample shares patterns similar to the actual labor division. The service industry (e.g. tourism, management) as well as the sales and office industry are adequately represented and account for 28% and 11% of the sample respectively. Government employees represent the second biggest category (21%). The inactive share of the sample, which comprises retired and unemployed respondents, make up 13% of the total. Finally, about 65% of those who answered other professional background were housewives.

Table 2.3 Professional background of the respondents

Rank	Profession	Share in total
1	Service & tourism	23%
2	Government/teacher	21%
3	Sales and office	11%
4	I am unemployed	9%
5	Management, professional, etc.	5%
6	I am retired	4%
7	Construction, transport & maintenance	4%
8	Student	1%
9	Farming, fishing and forestry	1%
10	US Government (non military)	1%
11	Other, specify	19%

As Table 2.4 shows, the highest level of education reached by the majority of the respondents (43%) is high school. A relatively high percentage of interviewees (34%) are currently enrolled in college or university, only 6% have a bachelor degree.

Table 2.4 Level of education

Level	Level of education	Share in total
1	Elementary school	15%
2	High school	43%
3	Some college or university	34%
4	Finished college (bachelor's degree)	6%
5	Advanced degree	1%
6	Don't know/refused	1%

Finally, respondents were asked about their annual gross household income. Surprisingly, 95 % of the respondents chose to disclose this information. As a result, it was possible to provide a distribution for level of income, which is representative of the entire sample. This distribution is presented in Table 2.5. It shows that more than half of the respondents have a household income less than $10,000. The average (mean) household income, based upon the respondents' information, is $15,000. This is lower than the median (US$ 22,555) and the mean (US$ 36,718) household income as reported in the 2002 CNMI Statistical Yearbook. This difference can possibly be explained by structural underreporting during the survey.

Table 2.5 Gross household income (US$/year)

Level	Income group	Share in total
1	$5,000 or less	33%
2	$5,000 to $10,000	25%
3	$10,000 to $20,000	15%
4	$20,000 to $35,000	18%
5	$35,000 to $50,000	6%
6	$50,000 to $75,000	2%
7	Over $75,000	1%

2.3 Recreation

For Saipan, like many other tropical islands, beaches and shoreline areas are popular recreation sites for tourists and residents. About 40% of the population lives along the coast and has direct access to marine related recreational services and facilities. As a result, activities such as swimming, snorkeling, fishing and barbequing seem to be widespread among locals as well as vacationers.

In order to confirm this observation, respondents were asked how often they usually engage in a number of recreational activities. Table 2.6 shows the average number of days per household per year spent on each recreational activity as well as the share of respondents that indicated to participate in these specific activities. Beach picnics and barbeques are, by far, the most common activities among respondents (97% of the respondents participated in this activity). According to the survey results, the average

household barbeques more than once a month (16.4 times a year). Swimming is the recreational activity with the second largest share of active respondents (94%). A good level of swimming skills among most household members supports this high level of participation in swimming. In fact, between 40% and 78% of the adult members are able to swim. In addition, 23% of the respondents claimed that all children in their household had good swimming skills. 25% and 15% of the respondents undertook fishing and snorkeling, respectively. Most time is spent swimming, enjoying beach picnics and barbeques, fishing and snorkeling which are all activities involving a direct contact with the coral reef. This confirms the strong link locals have with the marine ecosystem.

Finally, it is important to note that water sports such as jet skiing, kayaking, surfing and scuba diving, which require more technical equipment, are more an attraction for tourists rather than residents.

Table 2.6 Recreational activities on Saipan

Rank	Activity	Days per household/year	Share of active respondents
1	Swimming	18.2	94%
2	Beach picnic/barbeque	16.4	97%
3	Fishing	8.2	25%
4	Snorkeling	4.1	15%
5	Jet skiing	1.0	4%
6	Kayaking/paddling	0.6	3%
7	Body boarding/ surfing	0.4	2%
8	Scuba diving	0.4	2%

As a follow up question, households were asked to indicate the first, second, third and fourth most relevant conditions or facilities required for a full enjoyment of recreational activities. The four selected conditions/facilities were given decreasing weights (i.e. 0.5 for the first[t], 0.3 for the second, 0.15 for the third and 0.05 for the fourth). Finally, these were aggregated into one score and, ranked in order of importance as shown in Table 2.7.

In line with previous comments regarding respondents' high participation rate in swimming, clean and clear waters are considered to be the most important factor (31%), followed by good public facilities (26%). In fact, the wide availability of restrooms and barbeques further confirm the popularity of beach picnics. There is also public demand for clean and wide beaches (17%) followed by safe and calm waters (11%). This could explain the comparatively lower swimming skills of children, as was revealed in the survey, and the high level of risk associated with some coastal areas. Healthy coral reefs and abundant fish stocks are important for a high quality recreational experience of a smaller niche of respondents and in fact are essential requirements for those respondents who engage in scuba diving or recreational fisheries.

Table 2.7 Desired conditions and facilities for recreation on Saipan

Rank	Conditions and facilities	Importance
1	Clean and clear waters (unpolluted, good visibility)	31%
2	Good public facilities (e.g. barbeque, restroom)	26%
3	Clean and wide beach	17%
4	Safe and calm waters	11%
5	Healthy coral reefs	5%
6	Abundant fish stocks	4%
7	Plenty of parking space	3%
8	Proximity to home	2%
9	Other conditions	1%

2.4 The dietary importance of fish

Saipan boasts a diverse array of edible marine life, from deep water and reef fish to shellfish, octopus and sea cucumbers. As with many other southern Pacific islands, fish is an important part of the local diet and an integral part of the people's history and culture. Over the years, however, with the adaptation and integration of a more westernized lifestyle the diets of people have started to change. This is most notable in the island's youth where 33% of public school children, aged 6 through 11 are considered obese (CNMI-PSS, 2005).

On the whole, 45% of the survey respondents say that they eat "somewhat less fish" than they did 10 years ago. Table 2.8 shows the frequency that fish is consumed with the majority of respondents eating fish between 1 and 3 times a week. This shift in diet, especially among the youth, could pose potential health problems that were previously not present among the population.

Table 2.8 Frequency fish is consumed

Frequency	Share of respondents
Every Day	4%
Every 2 days	28%
Twice a week	27%
Once a week	23%
Every 2 weeks	6%
Once a month	12%

Table 2.9 shows where households acquire their fish. The majority of respondents purchase their fish from a store or restaurant (40%) while 33% purchase fish from roadside vendors. Acquiring fish from fishing themselves or from an extended relative/friend is not very common (11% and 13% respectively).

Table 2.9 Main sources of consumed fish/seafood

Rank	Source	Share of people	Share of fish consumed
1	Purchase it at a store/restaurant	40%	40%
2	Purchase it from the road side	31%	33%
3	Fish caught by an extended family member (e.g. uncle) or friend	13%	9%
4	Fish caught by myself or someone in my immediate family	11%	12%
5	Other	6%	6%

Households were also asked about the origins of the fish they consumed. The majority of the fish consumed is reported to come from the US mainland (41%) while the next most important source is from inside Saipan's reef (31%). Table 2.10 gives a ranked breakdown of the main origins of the consumed fish and seafood.

Table 2.10 Main origins of the consumed fish/seafood

Rank	Origin	Share of people	Share of fish consumed
1	Imported fish/seafood from the mainland (e.g. canned from US)	37%	41%
2	Reef fish and other species from inside Saipan's reef	30%	31%
3	Fish caught outside Saipan's reefs (e.g. deep water, pelagic)	23%	19%
4	Imported fish/seafood from other pacific islands (e.g. Chuuk)	10%	9%

2.5 Environment

The quality of Saipan's marine environment is closely linked to the residents' social and economic livelihoods. Therefore their perception of long-term changes is important. When asked whether the state of the marine environment had improved, remained stable or worsened in their lifetime, on average, 58% stated that it had worsened while only 6% felt it had improved and 5% thought it had remained stable. It should be noted however, that 30% stated, "I don't know".

The area stated to have declined the most is water quality (87% of respondents). It is no surprise that the most widely observed changes involve water quality as the majority of respondents rank swimming and beach going as their favorite leisure activities. Also for fisheries, although positive changes in fishery resources have been observed since the 2002 ban on the use of spear fishing with scuba, and 2003 restrictions on the use of gill, drag, and surround nets in the CNMI, many people who live on Saipan have noticed that fishery resources in many areas are still not what they were in the past. Figure 2.1 shows the overall picture of perceived changes in the marine environment.

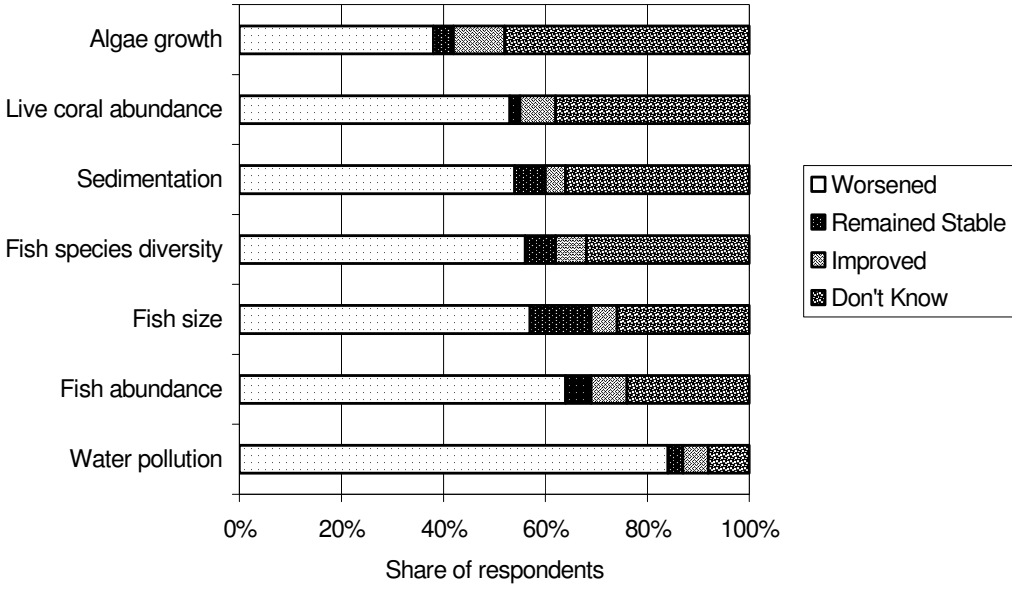

Figure 2.1 Perception of changes on Saipan's marine environment

In conjunction with the perceived changes in environmental quality, respondents were asked to rank in order of importance what they thought were the causes of environmental degradation. The results are shown in Table 2.11. The most frequently cited causes were leakage from broken sewer pipes (26%) and sedimentation due to poor development practices (22%); two aspects that have a direct effect on water pollution. These perceived causes are not only noted by the respondents; the CNMI Division of Environmental Quality and Division Fish and Wildlife also list leaking sewage as one of the reasons for a decline on Saipan's beach water quality.

Table 2.11 Perceived causes of environmental degradation

Rank	Perceived cause of environmental degradation	Importance
1	Leakage from broken sewage pipes	26%
2	Sedimentation due to poor development practices	22%
3	Increased runoff and stormwater	16%
4	Use of illegal fishing techniques (gillnets, night scuba)	14%
5	Increased pesticides/fertilizer from golf courses and hotels	6%
6	Too many fishermen	6%
7	Too many jet ski's, banana boats	4%
8	Don't know	3%
9	Sedimentation due to intentionally set fires	1%
10	Other	1%

As a follow up respondents were also asked: "What would you do if you were the CNMI Governor to improve the marine environment? The respondents were asked to rank in, order of priority, the most urgent measures needed. Linked to the key perceived cause of environmental degradation being water pollution, the majority of respondents wanted to improve the sewage system (22%), set/enforce stricter rules for development (18%) and educate children and the general public on the marine environment (15%). Issues directly related to tourist activities ranked rather low among respondents, as shown in Table 2.12.

Table 2.12 Perception of required management to improve the marine environment

Rank	Perceived required environmental measures	Importance
1	Improve the sewage system (e.g. repair/extend sewage pipe)	22%
2	Set and enforce stricter rules on development	18%
3	Educate children and general public about marine ecosystem	15%
4	Increase the penalties for violators of existing laws	9%
5	Better enforce existing laws	8%
6	Prohibit jet-skies in areas where they can damage the reefs	8%
7	Enforce the ban on scuba spear fishing (at night)	6%
8	Enforce the ban on use of gillnets	5%
9	Reduce pesticides/fertiliser use at golf courses and hotels	4%
10	Open the marine protected areas certain periods of the year	1%
11	Nothing. Things are fine the way they are	1%
12	Introduce a user fee for foreign scuba divers and snorkelers	1%
13	Limit human use to popular sites (i.e. divers, snorkelers)	1%
14	Outlaw the intentional setting of fires that cause sedimentation	0.5%
15	Other	0.5%

2.6 Fishing

Fish and other edible marine life probably constitute one of Saipan's greatest natural resources. Moreover, the cultural link to fishing helps to define who the people are and how they view themselves. In order to better understand the cultural importance of fishing on Saipan and the social and economic role it plays among households and individuals, a supplementary "Fishing" survey was annexed to the main household questionnaire. 79 respondents (roughly 20%) completed this survey, claiming to be active and/or "commercial" fishermen. Fishing in this case refers to any method of harvesting marine food from the sea including hook and line, spearing, netting, trapping, gathering shellfish, octopus, sea cucumber, etc. Table 2.13 shows the distribution of fishing techniques.

The overall majority of the respondents (76%) were experienced fishermen with more than ten years of experience. Among fishermen it is not common to own a boat. In fact, only 30% claimed to own one. This low level of boat ownership appears to coincide with the most important fishing techniques used, which is mainly made up of snorkel spear fishing (61% participation rate) and hook and line fishing in waters less than 100 feet deep. Both subsistence and recreational fishermen employ these techniques.

Table 2.13 Distribution of fishing techniques

Rank	Fishing type	Importance	Participation rate
1	Snorkel spear fishing	36%	61%
2	Bottom: hook & line (less than 100ft)	19%	37%
3	Trolling	13%	21%
4	Rod & Reel	12%	20%
5	Cast net (Talaya)	7%	15%
6	Trapping (octopus, crabs, etc.)	5%	21%
7	Bottom: hook & line (more than 100ft)	4%	9%
8	Foraging the reef (shell, crabs, etc)	1%	8%
9	Other Techniques	3%	5%

Table 2.14 presents the main motivations for fishing. As to the motivation for fishing, 32% say they fish because of enjoyment with 23% responding that they rely on their catch to feed their family. The cultural motivation for fishing, "Giving my catch to family and friends strengthens social bonds" and "Tradition: My family has always fished. Fishing is my life!" rank third and fourth with 13% and 12% respectively. There are few fishermen that fish for commercial purposes, with only 4% responding as such.

Table 2.14 Motives to go fishing

Rank	Motives for fishing	Importance
1	I really enjoy fishing	32%
2	I really need the fish to feed my family	23%
3	Giving catch to family & friends strengthens social bonds	13%
4	Tradition: My family has always fished. Fishing is my life!	12%
5	Fishing strengthens the bond with my children/family	6%
6	I really need the money from the fish I sell	4%
7	Fishing strengthens the bond with my fellow fishermen	2%
8	I go fishing to catch fish for fiestas/parties	2%
9	I do seasonal fishing for manahak, ti'ao, and e'e	2%
10	Other, specify …	4%

On average people go fishing 71days out of the year with the majority of people (26%) going once every 2-3 days while 24% fish once every two weeks (see Figure 2.2). The average trip duration is 4.4 hours with the majority of people (41%) fishing between 2 and 4 hours and 30% fishing between 4 and 6 hours.

In an effort to understand if fishing habits have changed over time, respondents with 10 or more years of experience were asked how often they fished 10 years ago as compared to now. The average number of days for experienced fisherman 10 years ago was 93 days per year as compared to their current 65 days.

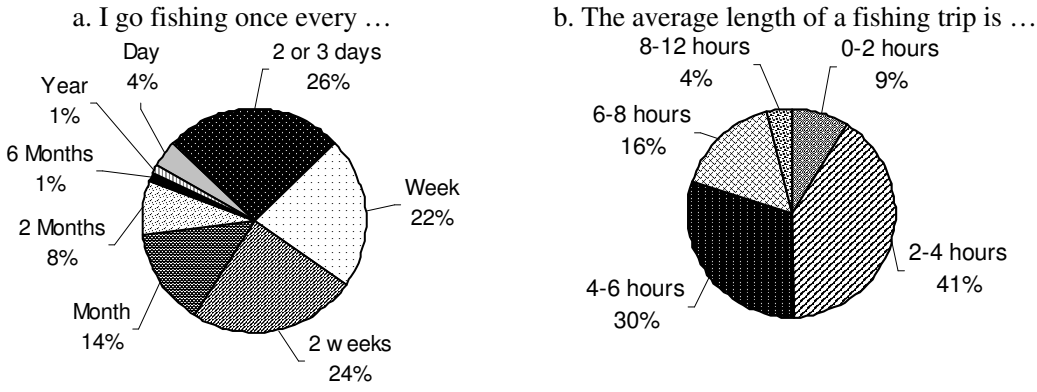

Figure 2.2 Fishing frequency and trip duration

Table 2.15 summarizes why fishing habits have changed over time. The main reason appears to be time-related (35%) with the second most important due to a decline in the quantity and size of fish (23%).

Table 2.15 Reasons for changing fishing habits

Rank	Reason for change	Importance
1	Because I have less/more time than before to go fishing	35%
2	Because fish availability has changed (quantity and size)	23%
3	Because I grew older	11%
4	Because the cost of fishing has changed (fuel, gear, etc)	6%
5	Because the need for fish for my family has changed	5%
6	Because the need for additional income from fishing has changed	4%
7	Because my family changed their fish diet	1%
8	Other	15%

The next set of questions that were asked dealt with the type of fish caught, how much each fisherman usually catches and what they do with their catch. The most frequently caught fish are Saipan reef fish (54%), followed by shallow water bottom fish (23%) and reef invertebrates such as octopus, shellfish and crabs (14%). The median monthly catch is 40lbs per person. Respondents report that 70% of their catch is consumed by themselves and immediate family, with another 20% consumed by extended family and friends. Only 8% the catch is actually sold. If these numbers are viewed alongside the main motivations for fishing, as listed above, they suggest that fishing plays a much stronger cultural role for households rather than an economic one.

Eighteen of the respondents who completed the supplemental fishing survey identified themselves as "commercial" fishermen and answered the question on their monthly income. The median income was calculated to be $200. It should be noted however that their average monthly income was calculated to be $1,137. This large discrepancy is due to there being 3 respondents who have monthly incomes over $3,000. If these 3 are taken as outliers then the average monthly income can be recalculated to be $124.

Looking at the median and average monthly costs to these "selling" fishermen (Table 2.16), and excluding the outliers above, the largest expenses go to fishing equipment (94% share of respondents) and fuel/oil (79% share of respondents). While only 30% are

boat owners, fuel and oil rank as the second highest among expenses which is most likely due to the fishermen paying the actual boat owners' fuel costs.

Table 2.16 Average monthly fishing expenses (US$ per month)

Cost item	Median	Average	Share of response
Fuel & oil	$40	$56	79%
Ice	$10	$17	61%
Bait	$20	$20	51%
Fishing Equipment	$55	$86	94%
Other expenses	$25	$24	7%
Total	$150	$203	

The ratio of monthly costs to sales ratio in Figure 2.3 shows an interesting pattern: costs exceed sales for almost every income category of fishermen except those earning over $501 a month and those earning less than $26. This suggests that the bulk of "selling" fishermen are not selling to earn a profit, i.e. that fishing is not a business for them but rather they sell their catch simply to recover some of the costs for their activities.

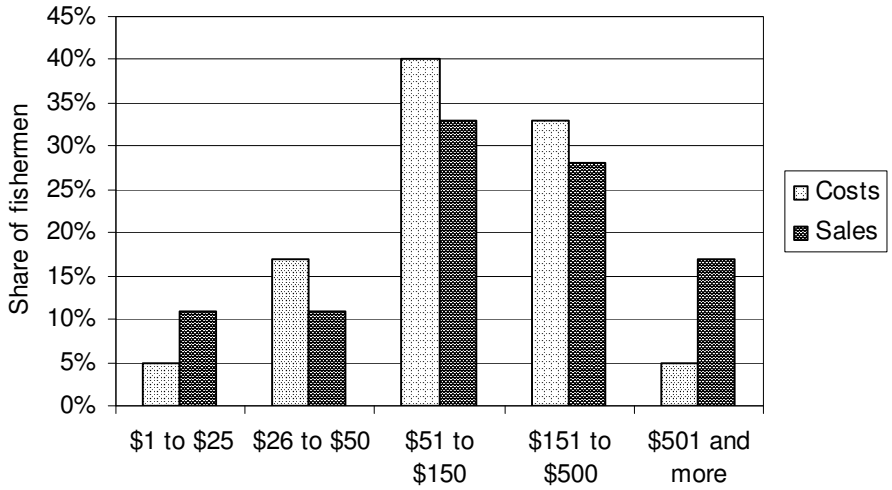

Figure 2.3 Distribution of total fishing-related costs and benefits

3. Choice modeling for households

3.1 Introduction

The household survey described in the previous Chapter also included a discrete choice survey, which was designed to estimate values for some of the non-market benefits associated with Saipan's coral reefs, including cultural/traditional, recreational, and non-use values. Before presenting the choice model, the methodological background of discrete choice modeling methods in the context of economic valuation methods is provided. We also provide a general overview to the theory and methods associated with choice modeling and conclude with an overview of the development and implementation of the stated choice experiment used to define the non-market benefits associated with Saipan's coral reefs. Section 3.3 and 3.4 provide the results and final conclusions, respectively.

3.2 Valuing non-market goods

Coral reefs provide considerable value to Saipan's residents, which cannot be measured by market activity alone. As a small island in the middle of the Pacific, Saipan's economy was traditionally dependant on resources provided by the reefs. As a result, the original Chamorro population developed a rich fishing culture. Today, modern descendents of Saipan's original Chamorro people and many residents who have migrated to the island place a high value on maintaining the social and cultural values associated with reefs. For example, the migratory return of traditional fish such as ti'ao (juvenile goat fish), and manahak (juvenile rabbit fish) are times of special significance that bring friends and families together to share in the harvest. In addition to more traditional cultural values, the reefs and reef beaches provide residents with locations for Fiestas and BBQs, sheltered locations for swimming, and opportunities to enjoy nature.

Since the importance of traditional, cultural, recreational, and non-use coral reef values is not completely reflected by market activity, traditional market-based economic techniques that rely on observing the behavior of real markets cannot be used entirely to estimate non-market values. Instead, stated preference methods can be used. The best known stated preference valuation method is the contingent valuation method (CVM). In a CVM study, the survey environment is used to create a hypothetical market for a non-market good or service (e.g. cultural fish or local recreation) usually by giving a detailed description of the non-market benefit (Mitchell & Carson, 1989). In the simplest case, respondents are asked how much they would be willing to pay for a change from the current situation to a hypothetical future situation. However, many researchers have raised concerns about the ability of CVM studies to derive valid estimates of economic value (see Kahneman & Knetsch, 1992, for a discussion of some of the limitations of CVM).

The discrete choice experiment (DCE) is another stated preference research method that addresses a number of the difficulties traditionally associated with contingent valuation methods. Rather than simply asking respondents how much they are willing to pay for a single improvement in a given non-market good, a DCE requires respondents to

repeatedly choose between complex, multiattribute profiles which describe various changes in non-market benefits at a given cost (e.g. a change in tax paid). Discrete choice modelling has been used to estimate the value of a wide variety of environmental goods and services, including recreation activities (Adamowicz *et al.* 1994), caribou preservation (Adamowicz*et al.*1998a), environmentally sensitive areas (Hanley *et al.,* 1998), forest management (Hanley*et al.*1998b), wetland quality (Morrison *et al.*1999), and desert vegetation (Blamey *et al.* 2000).

3.3 Discrete choice experiment

The discrete choice experiment is a stated preference evaluation technique that originated in transportation research, and has been applied extensively in the fields of applied decision-making and market research (Adamowicz *et al*., 1998). Originally choice theory was used to model actual behavior (revealed preference methods). When applied to the analysis of behavioural or preference information derived from the evaluations of hypothetical profiles or choice sets, it is referred to as stated preference / choice modelling (Louviere et al, 2000).[3]

In a typical DCE study, respondents are presented with a series of choice sets composed of two or more multi-attribute alternatives (one alternative is often the status quo). For each choice set, a respondent evaluates the alternatives and chooses a preferred option. The alternative options in each choice set are described by a common set of attributes, which summarize the important aspects of the alternatives. For example, a choice experiment on automobile preferences might include attributes that describe cost, fuel economy, and safety features. Each attribute is defined by at least two distinct levels, which are varied systematically between the choice sets according to an underlying statistical experimental design plan.

The choice preferences of all the respondents are aggregated and analyzed using statistical methods based on choice theory to obtain utility or value functions for each attribute over the range of attribute levels used in the experiment. The part-worth utilities associated with each attribute level demonstrate their overall importance or contribution to the choices made by the survey respondents. In addition, ratios of utility coefficients also indicate compensating marginal values between different attributes.

For more details on the background of choice modeling, the appendix provides a more in-depth explanation of the underlying principles of this valuation method.

Survey Development for Saipan

The choice experiment survey for this study on non-market values associated with Saipan's coral reefs was developed through a series of discussions with experts, focus groups, and pre-tests in the field. The main purpose of these activities was to identify and describe the most relevant attributes and levels associated with the non-market values of Saipan's coral reefs. Specifically, the coral reef values that Saipan's residents associate

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[3] Another common stated preference technique is conjoint analysis, which is based on the evaluation on individual profiles. Unlike discrete choice methods, conjoint techniques do not have a behavioural basis in random utility theory.

with recreational use, non-commercial fishing, cultural fish species, water pollution, and reef management options were explored. The final attributes and attribute levels chosen for the choice experiment are summarized in Table 3.1. They reflect the need to describe possible changes in the indirect non-market benefits associated with the reefs and an appropriate payment vehicle, which allows the estimation of dollar values for each non-market benefit.

Table 3.1 Attributes and attribute levels used for the discrete choice experiment among households on Saipan

Attribute	Level description
Reef Recreation –	20% less
Number of recreation areas provided by Saipan's coral reefs	No Change
	20% more
Fish Catch –	One meal
Reef fish and seafood caught during the average fishing trip	One meal and sharing
is enough for …	One meal, sharing and selling
Culturally significant Fish –	20% less
The amount of culturally significant fish (e.g. manahak –	No Change
baby rabbit fish and ti'ao – baby goatfish)	20% more
Size of the Marine Protected Area –	No Change
	1.5 times current MPA
	2 times current MPA
Pollution from Land –	20% less
Change in the amount of pollution discharged onto the reef	No Change
(e.g. sediment, sewage)	20% more
Income Tax –	$40/year less
Change in the amount of income tax that you pay on a yearly	$20/year less
basis.	No Change
	$20/year more
	$40/year more
	$60/year more

The alternative options appearing in the choice sets were derived by combining the levels associated with the six variables using a fractional factorial design plan. For this survey, a fractional factorial representation of a resolution III main effects design (Addelman, 1962) requires 36 replications, which were evenly divided between 9 versions. As a result, each respondent was only required to evaluate four choice sets. Each choice set (Figure 3.1) contained two hypothetical alternatives 1 and 2, and one additional scenario describing the status quo situation. Respondents were asked to indicate their preference between the three alternative options.

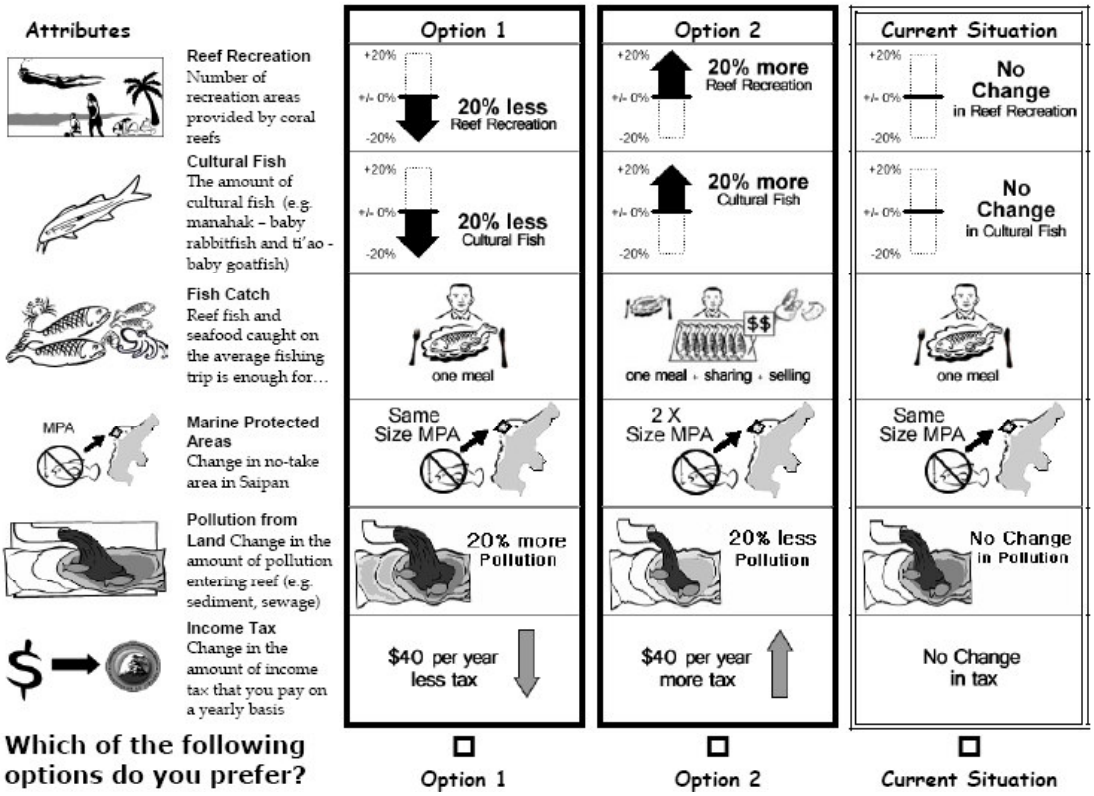

Figure 3.1 Example of a choice set

The written descriptions of the attributes and levels were supplemented with pictograms and graphic scales to help make information processing easier for the respondents and to provide assistance to semi-literate or illiterate respondents. For each of the nine versions, the four experimental choice sets and one common set (a choice set that was the same for all version) were printed on a unique colour of paper. Each choice set was printed on a separate sheet of paper, laminated, and then the nine versions were bound in small spiral binder, one for each interviewer. The choice experiment was conducted as part of the larger household survey (see Chapter 2). Each interviewer carried a full set of choice cards and cycled through the versions as each interview was completed (one version per respondent). The version and the respondent's choices were recording on a response sheet. The interviewers were trained prior to data collection on the basic principles of choice experiments, how to properly administer the choice experiment without introducing bias into the results, and to provide assistance to respondents in understanding the task. Each interviewer was also provided with a detailed interview protocol to ensure that survey administration and data collection were completed in an efficient and consistent manner.

Following the completion of the surveys, the 375 responses were coded in a spreadsheet. Analysis of the DCE was performed with econometric software called LIMDEP v.7 (Greene, 1998). Maximum likelihood estimation was used to estimate the choice parameters based on a multinomial logit model.

3.4 Results

General Model Development

The main results of the Choice Experiment are shown in Table 3.2. The lessons we can learn from the analysis include:

- Whether an attribute is genuinely important for local communities in the way they perceive the marine environment (i.e. which attributes are statistically significant and thus have a *t*-value of two or more);
- How important these attributes are, relative to each other (i.e. what is the value of the coefficient of each significant attribute).

Table 3.2 presents the parameter coefficients, their standard errors, and *t*-values for each attribute over the entire survey sample. Significant coefficients ($p<0.05$) are marked in bold. The results for the overall model are also presented graphically in Figure 3.2. The model is coded as a mix of dummy coding and linear coding.[4] Even though all variables were specified at 3, 4 or 6 levels, it is possible to apply continuous coding to attributes with numeric variable specifications (i.e. reef recreation, cultural fish, pollution, and income tax). Dummy coding was used for the fish catch and MPA attributes since they are categorical variables.

The choice experiment contained two generic options (A or B), and a base alternative (status quo). The generic nature of the design allowed parameter estimates to be derived for each variable and a single intercept associated with choice options A and B. The intercept estimate for the options is not significantly different from the base alternative, indicating that everything else being equal, the alternative options would be chosen about the same number of times as the base.

Table 3.2 DCE - Main Model, all respondents (significant t-values in bold)

Attributes	Level	Coefficient	SE	T-Value
	Status Quo	0.000		
	Alternatives	0.228	0.386	0.59
Reef Recreation	Linear	0.563	0.205	**2.75**
Fish Catch	One meal	0.000		
	One meal + sharing	-0.463	0.398	-1.16
	One meal + sharing + selling	0.132	0.378	0.35
Culturally significant Fish	Linear	0.746	0.215	**3.47**
Fishery & Reef Management	Same size	0.000		
Practices	1.5X larger	0.615	0.334	1.84
	2.0X larger	0.537	0.339	1.58
Pollution from Land	Linear	-1.817	0.223	**-8.15**
Income Tax	Linear	-0.759	0.250	**-3.04**

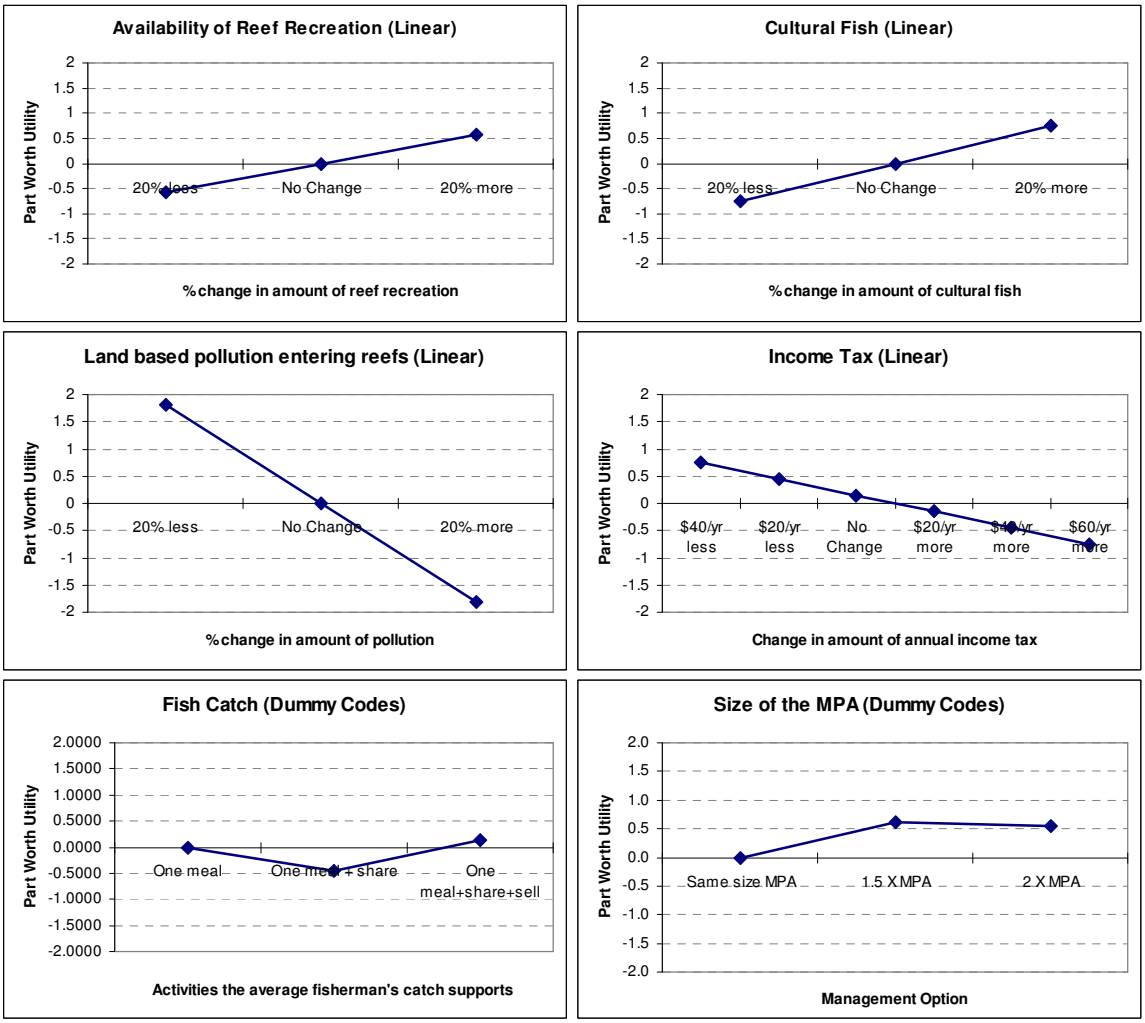

Figure 3.2 Utility estimates for DCE attributes

For the attributes estimated with continuous value functions - namely recreation, cultural fish, pollution and income tax - a linear equation provided the best fit. All four linear coefficients are significant and have the correct sign (e.g. there is a negative marginal utility associated with increasing income tax). None of the quadratic estimates were significant and were therefore dropped from the final model. The linear estimate of the coefficient represents the slope of the utility function associated with each attribute or, in other words, the change in marginal utility per unit change in the attribute value.[5]

For the dummy coded attributes 'fish catch' and 'size of the MPA', part-worth utilities are derived for each attribute level. With dummy coding, the part-worth utility

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[4] The final model is based on a subset of the original survey responses. Extensive analysis of the results indicated that only a limited subset of the interviewees interpreted and responded to the choice experiment in a meaningful way; all these responses are associated with one interviewer only. Consequently, the remaining response to the choice experiment needed to be discarded. This did not affect the results of the remaining survey analysis in any way.

[5] Note that the exact interpretation of the coefficients depends on the coding used in the model. For example, the recreation utility coefficient is associated with a unit change of 20% in the level of recreation because a factor of 20 was used to develop the linear coding.

coefficients are normalized to a base value, which is usually the lowest or zero level. In other words, part-worth utility coefficients are interpreted relative to the base value:

- For *fish catch*, the utility associated with having enough fish to share and to sell was positive, but the coefficient was not significantly different from the status quo value of one meal. Surprisingly, the coefficient associated with one meal and sharing is negative; however, because this coefficient is statistically insignificant, the value cannot be interpreted to have any particular relevance.
- The results for the *MPA attribute* suggest that the residents of Saipan support increasing the size of the MPA (sign at the 10% level); however, the model could not determine that either alternative MPA sizes were significantly preferred to the status quo.

Comparing the range of part-worth utility values associated with each attribute gives an indication of how important an attribute was to respondents when making choices between alternative options. The ranges of utility values shown in Figure 3.2 indicate that the pollution attribute was the most influential and dominant attribute. This result is not surprising given that, according to responses to other questions in the household survey, Saipan's residents perceive a variety of pollution issues on the island (see Chapter 2).

Economic Values for Non-market Attributes

As stated previously, one of the primary motivations for the choice experiment was to provide a method for valuing non-market benefits associated with Saipan's coral reefs. The trade-offs made by respondents between the monetary tax attribute and the other non-monetary attributes in the choice experiment, indicates the compensation required for changes in the non-market values. The marginal willingness to pay for an increase in the non-market attribute can be calculated by estimating the sensitivity of non-market attributes to the income tax attribute. Using this method, economic values were derived for each of the five non-monetary attributes in the choice experiment (see Table 3.3).

When interpreting Table 3.3, care must be taken to use an appropriate base when comparing the WTP between attributes that are measured on a per unit basis (e.g. recreation, cultural fish, and pollution) and those measured by individual attribute levels (e.g. reef management and fish catch). For example, the WTP associated with a 20% increase in recreation is $37.20 (20*$1.86). The people of Saipan most explicitly value a reduction in pollution. Residents would be willing to pay almost $6 for each percent decrease in water pollution. The policy makers of Saipan can use these numbers to justify further investments in coral reef and fishery management.

Table 3.3 WTP values for attributes in the DCE

Attribute	Economic Value	Units
Reef Recreation	$1.86	$/% increase
Culturally significant Fish	$2.46	$/% increase
Fish Catch:		
- one meal and sharing	-$30.50*	Relative to one meal
- one meal and sharing and selling	$8.72*	Relative to one meal
Reef Pollution	$5.99	$/% decrease
Reef Management Options:		
- 1.5 times larger	$40.55*	Relative to same size
- 2.0 times larger	$35.39*	Relative to same size

* The coefficients on which these values are based are not significant (p-0.05).

3.5 Discussion

Saipan's coral reefs provide important cultural, recreational, and non-commercial fishing values that are not easy to measure using traditional economic methods. Individuals may value or enjoy various aspects of the reef or services that the reef provide but may never have to pay directly or indirectly for these benefits. Furthermore, these non-market values may be difficult to define and harder yet to quantify. However, it is extremely important to include non-market values in economic assessments to ensure that governments and policy makers are aware of the full value associated with natural assets such as coral reefs.

The discrete choice experiment implemented for this research project investigated three important non-market benefits associated with Saipan's coral reefs: (1) local recreational use, (2) abundance of cultural fish species, and (3) non-commercial fishing values. In addition, a (4) pollution attribute and a (5) reef management attribute were also included in the choice experiment as two factors affecting reef health. The pollution attribute measured preferences for controlling land-based sources of pollution including sedimentation, runoff, and sewage outflow, while the reef management attribute measured preferences for increasing the size of the MPA. Income tax was included as monetary variable in the choice experiment to provide a suitable payment vehicle for willingness to pay calculations.

The results of the DCE indicate that significant economic values are associated with two of the three non-market benefits included in the survey. Saipan's residents appear to place a similar value on the ability of the reefs to provide local recreational benefits and supply cultural fish species.

Although there is some indication that Saipan's residents may support increasing the size of the MPA in the lagoon, they are much more concerned with the effects of pollution and managing pollution as a threat to the reefs. The importance of the pollution attribute is not surprising since pollution has negative effects on both consumptive (e.g. fishing) and non-consumptive benefits (e.g. snorkeling, using the beach), several pollution related issues have been reported in the media, and the government and NGOs have initiated public relations campaigns to educate about the sensitive reef ecosystems,

Overall the results of this study demonstrate that the DCE tool for valuing non-market benefits and can be used in a complementary manner with more traditional economic valuation methods. The DCE is an efficient means of collecting information, since choice tasks require respondents to simultaneous evaluate multi-attribute profiles. In addition, economic values are not elicited directly but are inferred by the trade-offs respondents make between monetary and non-monetary attributes. As a result, it is less likely that WTP information will be biased by strategic response behavior. Moreover, and perhaps most importantly in the context of non-market valuation, choice experiments allow individuals to respond to non-market benefits that are described in an intuitive and meaningful way, but without asking respondents to complete the potentially objectionable task of directly assigning dollar figures to important values such as culture.

4. Tourism and retention

4.1 Introduction

In this Chapter a general view of tourism on Saipan is provided after which we discuss the outcome of the tourist exit survey executed by Cesar Environmental Economics Consulting (CEEC). Hereafter some general remarks about marine related tourism are made and the last paragraph deals about the issue of retention.

We conducted a tourist exit survey at Saipan International Airport in order to retrieve more information about the background of the visitors to Saipan, such as visitor characteristics, trip characteristics and motivation. The data was collected using face-to-face interviews from a random sample of 272 departing foreign passengers.

4.2 Tourism in general

The World Travel and Tourism Council (WTTC) predict Oceania's[6] travel and tourism to grow 8.1% in 2005 and by 5% per annum, in real terms, between 2006 and 2015[7]. Southeast Asia's[8] Travel & Tourism is expected to grow 6.3% in 2005 and by 6.2% per annum, in real terms, between 2006 and 2015[9].

For this study, we assume an increase in tourism in the future, although the tourist arrivals in the CNMI have declined from 1996 (see Figure 4.1). There are several reasons for this decline, such as the conflict in Iraq, the SARS epidemic, the terrorist attacks on New York and Washington and the Indian Ocean Tsunami. The majority of the 475,547 visitors arriving in 2002 in the CNMI came from Japan (68.7%). The remaining visitors came from Korea (19%),USA including Guam (7.5%) and China (2.2%) (CNMI Economic Report 2003). Tourist spending in 1999-2000 was estimated at $ 400 million to $ 430 million.

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6 WTTC defines Oceania as the countries Australia, Fiji, Kiribati, New Zealand, Other Oceania, Solomon Islands, Tonga, Vanuatu

7 In 2005 the travel and tourism in Oceania is expected to generate USD128.6 billion of economic activity. Oceania's Travel & Tourism Economy (direct and indirect impact) in 2005 is expected to account for 13.3% of GDP and 1,893,780 jobs (14.8% of total employment). (Source: WTTC)

8 WTTC defines Southeast Asia as the countries Brunei Darussalam, Burma, Cambodia, Indonesia, Laos, Malaysia, Papua New Guinea, Philippines, Singapore, Thailand, Vietnam

9 In 2005 the travel and tourism in Southeast Asia is expected to generate USD165.5 billion of economic activity. Southeast Asia's Travel & Tourism Economy (direct and indirect impact) is expected to account for 7.5% of GDP and 19,306,000 jobs (7.9% of total employment) in 2005. (Source: WTTC)

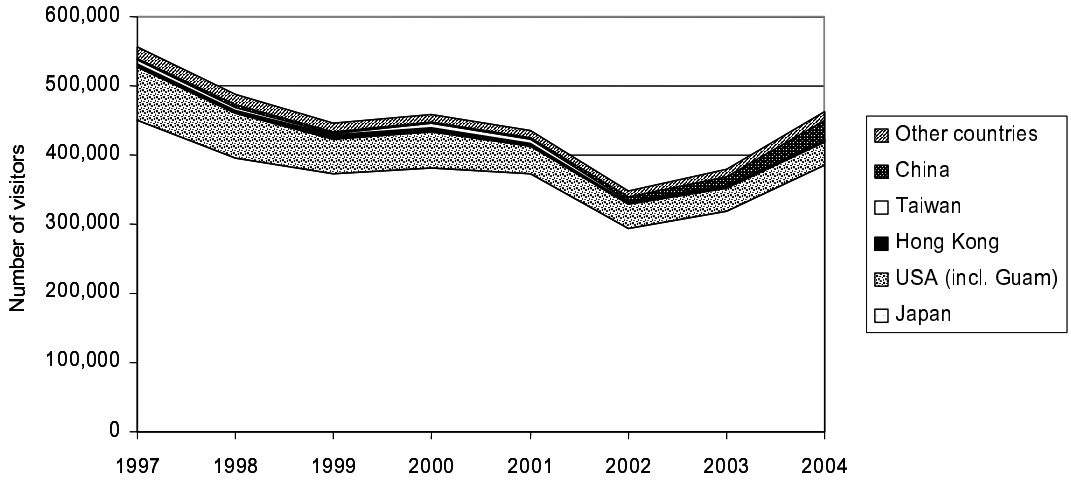

Figure 4.1 Visitor arrivals over time (1997-2004)

Source: Mariana's Visitors Authority (2005) Commonwealth of the Northern Mariana Islands Visitor Arrivals Statistics.

Specific information about tourism industries is provided by the U.S. Department of Commerce. In 2002 the accommodation services had 32 establishments for accommodation[10] with total revenue of $ 143.8 million[11] in 2002. Food services and drinking places[12] exist at 119 locations on CNMI with a total revenue of $ 53.4 million[13] in 2002.

In 2002, the arts, entertainment and recreation industry generated revenue of $ 29.3 million of which $ 28.7 million is from amusement, gambling & recreation (U.S. Department of Commerce 2002). Note however, the income generated by the tourist industry is not limited to the above sectors; also the retail trade and other services, such as the transport service earn revenues from the arrival of tourists.

The Marianas Visitors Authority (MVA) is expecting tourist arrivals to increase to 530,000 in 2004. In order to increase the number of visitors to Saipan, the MVA wants a supplemental budget of $ 2 million[14] on top of the $ 6 million it receives in annual appropriation. The MVA will use the additional amount to fund its marketing promotions and to improve specific geographic areas that are important to the business of tourism.

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[10] Of the 32 establishments 30 were hotels and motels, one casino hotel (The Dynasty Hotel and Casino) and one other traveler accommodation. The occupancy rate of the hotels was 63.4% in 2002 and the average rate per room was USD 81.46 per night in 2002. 85% of all hotel rooms are on Saipan (CNMI Economic Report 2003).

[11] According to the CNMI Department of Finance total revenue was USD 91.2 million in 2002 .

[12] 53 were full service restaurants (revenue of USD 24.2 million in 2002), 23 were limited-service eating places (revenue of USD 12.9 million in 2002), 6 special food services (revenue of USD 8.2 million in 2002) and 29 drinking places (alcohol beverages) (revenue of USD 7 million in 2002) (CNMI Economic Report 2003).

[13] According to the CNMI Department of Finance total revenue was USD 58.9 million in 2002.

[14] The additional USD 2 million should be made available from the Managaha landing fees (Source: Saipan Tribune 5/9/2005 and 4/2/2005)

4.3 Tourist exit survey

The surveys used for data in this Section include the following sources:

- CEEC tourist exit survey on 272 departing foreign passengers at Saipan International Airport in 2004;
- Market Research & Development Inc (supervised by MVA) on 300 departing Korean passengers in October 2003;
- Market Research & Development Inc (supervised by MVA) on 400 departing Japanese passengers in July 2003 and 626 departing Japanese passengers in 2003;
- Tourist Exit Survey executed by Saipan College Students on 272 departing visitors.

The combination of these sources allowed us to determine a comprehensive understanding of the different groups coming to Saipan. The tourist exit survey investigated both the socio-economic and demographic background of respondents. We have also included results from the tourist exit surveys executed by college students from Saipan and by Market Research & Development, Inc. 2003 under supervision of the MVA. These additional surveys have enabled us to gain insight into the behavior of the Japanese and Korean visitors in comparison to the average visitor on CNMI.

The country of origin of each respondent is presented in Table 4.1 which shows the proportion of each region defined in the sample collected by Northern Marianas College students (column 1) and compares this with the actual visitor numbers to CNMI in 2002 (column 2). With only 28% of the total sample, Japan is underrepresented in the student tourist exit survey, and Hong Kong with 11% is overrepresented. This may be due to specific national holidays. Also China has a higher share in the tourist exit survey then the actual number of Chinese visitors in 2002. This is due to the exponential increase of Chinese tourists coming to CNMI.

The under- and overrepresentation of the different nationalities does not have an impact on the final result. By using the above-mentioned sources in combination with the student survey, sufficiently sized samples have been created of each group to determine a reliable profile of each nationality. Next, the specific characteristic of each nationality has been extrapolated to the national level by using the actual composition of the tourist population, as provided by the MVA.

Table 4.1 Country of origin of visitors interviewed in 2004 by College students compared to the actual total number of visitors to CNMI in 2002

Country	Interview 2004	Total visitors 2002
Japan	28 %	69 %
Korea	17 %	19 %
Guam/ Micronesia	12 %	8 % °
Hong Kong	11 %	1 % [1]
US Mainland	10 %	-
PR China	9 %	2 %
Taiwan	5 %	-
Other	9 %	2 %

° Including share US Mainland

[1] Including share Taiwan

Source: Tourist exit survey and Bank of Hawaii 2003

Overall trends in tourism

The growth potential of the Japanese, Korean and Chinese tourism is enormous. The Japanese national total of personal travel and tourism[15] spending is estimated at $286.8 billion or 10.4% of total personal Japanese consumption in year 2005 and is growing.

The Korean tourist is the second biggest market for CNMI. Korea's economic recovery and the growth of its per capita income increase the spending on travel and tourism. According to WTTC, the national total of personal travel and tourism of Korea is estimated at $ 31.5 billion in year 2005 (Source: WTTC).

The Chinese tourism market is also growing; the number of Chinese visitors to CNMI increased nearly five-fold to 10,471 in 2002 (CNMI Economic Report 2003). By 2015, the national Chinese travel and tourism consumption should reach $306.5 billion or 12.0% of total Chinese consumption (Source: WTTC)[16]. The growth in the Chinese economy and the upcoming travel liberalization in China make the Chinese tourist market very promising for CNMI. Initiatives such as the Dynasty Hotel and Casino on Tinian, developed mainly for Chinese travelers and gamblers is a good example of preparation for this new market.

Visitor profile

Table 4.2 summarizes the type of travel arranged by respondents. More than half of the visitors (60%) made use of a full package arrangement,[17]while one-tenth took part in a group tour (11%). Only a small percentage (12%) arranged full independent travel. According to Market Research & Development, Inc. (2004)[18] about more then half of the Japanese visitors (60%) came on a full package tour and only a small percentage (8%) came with a group tour. In comparison, the majority of the Korean visitors came to the CNMI on a packaged tour (41%) or arranged the trip themselves (41%) (Market Research & Development 2003).

Table 4.2 Type of travel arrangement

Rank	Type	Share
1	Full package	60%
2	Free-time package	16%
3	Individually arranged	12%
4	Group tour	11%
5	Others (specify)	1%

[15] More formally known as Travel & Tourism Personal Consumption, this category includes all personal spending by an economy's residents on Travel & Tourism services (lodging, transportation, entertainment, meals, financial services, etc) and goods (durable and nondurable) used for Travel & Tourism activities. Spending may occur before, during or after a trip. Spending covers all Travel & Tourism, outbound and domestic (Source WTTC).

[16] The China Personal Travel & Tourism is estimated at US$89.9 billion or 10.8% of total personal consumption in year 2005 (Source: WTTC).

[17] Full-package arrangement includes airfare, airport transfers, hotel, meals, and in some cases local transportation and optional tours. Free-time package includes airfare and hotel only.

[18] Market Research & Development, Inc. (2004) executed tourist exit surveys every month in 2004 to gather more information about Japanese and Korean tourist.

Most of the respondents are married (66%), with 26% traveling with his or her spouse and 20% traveling with their family.

The average age of visitors to CNMI is 34 years old. The majority of visitors are aged between 26 and 35 years old. These visitors, together with those aged between 18 and 25, are the visitors most likely to be involved in all kind of recreational activities. The average income of the CNMI visitor is $33,022, which is more than the average purchasing power of Japan[19] and Korea[20], but less than the purchasing power of the US$[21]. According to Market Research & Development, Inc. (2003) the Japanese respondents had personal incomes between $30,000 and $50,000 per year. The Korean respondents at CNMI stated that they earn an income between $25,000 and $30,000 per year (Market Research & Development, Inc. 2003). In summary, we can conclude that the more wealthy citizens of Japan and Korea visit CNMI.

As shown in Table 4.3, on average the time spent on Saipan by the interviewed visitors was 3.14 days. The Japanese tourists stayed in average 3.5 nights on Saipan and the Korean tourist 4.52 nights (Market Research & Development, Inc. 2004)[22]. Clearly, the average visitor is coming to CNMI for a short holiday.[23] Therefore, there is limited time to visit all nature and marine parks in CNMI. Around one-third of the Japanese visitors (35%) and one-fifth of the Korean travelers (21%) had been to the CNMI before. This provides an opportunity to invest in those visitors the first time they arrive; possibilities are to set up frequency awarding programs, such as for each visit to a certain area visitors collect points with which they can receive a special gift or special treatment.

Table 4.3 Days spent in CNMI

Island	Tourist exit survey CEEC	Korean tourist exit survey	Japanese tourist exit survey July	Japanese tourist exit survey August
Saipan	3.14	4.52	3.60	3.40
Rota	0.11	1.00	3.50	3.40
Tinian	0.49	5.45	2.30	2.40

Table 4.4 shows that most of the visitors made an advance payment confirming the observation that the majority of respondents visited Saipan with a full package arrangement 85% of visitors spend a relatively small amount of money on the island (up to $500) once they arrive on Saipan (see Table 4.5). Table 4.6 summarizes the total payments made by visitors to Saipan. For 76% of the visitors' total payment was less than $1,000. Results from the MVA Korean and Japanese Visitors Survey and the Saipan college student tourist exit survey show the average prepaid visitor expenditure ranges between $573 and $874, while on-island expenditure ranges between $390 and $926. According to these surveys visitors spend between $52 and $604 on hotel food and

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19 2004 estimated of Japan purchasing power parity is $29,400 (CIA Factbook)

20 2004 estimates of Korean purchasing power parity is $19,200 (CIA Factbook)

21 2004 estimates of US purchasing power parity is $40,100 (CIA Factbook.)

22 The Visitor Profiles of 2004 show that the Japanese stay at average 3.3 nights in CNMI and the Korean visitor 3.71 nights.

23 Just a small percentage of the visitors come to CNMI for business; less then 1% of the Japanese visitors, 2% of the Korean visitors (Market Research & Development, Inc.2004).

beverages, and between $78 and $503 outside the hotel. Visitors also spend between $116 and $542 on optional tours and activities, and $123 to $248 for gifts and souvenirs for themselves or for family and friends.

Table 4.4 Advance payment

Range	Share of visitors	Share of revenues
0-$500	60%	21%
$501-$1,000	25%	30%
$1,001-$2,000	11%	34%
$2,000>	3%	15%

Table 4.5 On-island payments

Range	Share of visitors	Share of revenues
0-$250	45%	17%
$250-$500	40%	44%
$501-$750	9%	16%
$751-$1000	7%	23%
$1,000>	0%	0%

Table 4.6 Total payment

Range	Share of visitors	Share of revenues
0-$500	37%	13%
$501-$1,000	39%	36%
$1,001-$1,500	11%	16%
$1,501-$2,000	6%	12%
$2,001-$3,000	7%	23%
$3,000>	2%	10%

It is important to note however, that the amount mentioned by the tourist exit survey from the Saipan college students deviates by up to a factor 10 from the other tourist exit surveys. Therefore, the validity of the figures of the college student survey should be investigated (See Table 4.7).

Table 4.7 Expenditures by 4 Tourist Exit Surveys (TES)

Expenditures per interviewee in $°	CEEC TES	Korean TES	Japanese TES July	Japanese TES August	College students
Prepaid expenditures	504	763	836	573	847
On-island expenditures	346	407	496	390	926
Food & beverages (F & B) in hotel	126	62	64	52	604
F & B in restaurants and stores	NA	35	20	23	503
F & B at Drinking Establishments	NA	61	67	55	NA
Optional tours/ activities	187	177	116	119	542
Gifts/souvenirs	222	248	183	155	123
Local transportation	11	64	9	25	NA
Other expenses	71	80	47	96	NA
Total on-island expenditure**	639	407	513	390	NA

NA = Not available

° Note however it is not clear if these expenditures are per person or per group of the interviewee

** Not the sum of categories but a separately reported total.

4.4 Marine related tourism

Properly designed Marine Protected Areas (MPAs) can provide several direct and indirect benefits to the tourism industry. Enhanced attractiveness of reefs – maintaining and enhancing coral cover, fish stock and coral and fish diversity will increase satisfaction from diving, snorkeling and glass bottom boat rides. However, there are both ecological and economic controversies surrounding nature tourism. For example, unrestricted use of sensitive protected areas can lead to overuse and subsequent degradation of the ecosystem. Impacts from tourism activities include both direct physical impacts, such as diver damage and over-exploitation of reef species, threatening local survival of endangered species and damage caused by the demand for seafood by tourists, as well as indirect impacts from resort development and operation, development of tourism infrastructure in general and by tourism-related sources of sewage.

The emergence of ecotourism has begun to introduce new dynamics into the industry; visitors encourage sustainable development by putting a high value on well-preserved environments, and try to damage as little as possible. This kind of tourism is gradually growing from a niche market to big tour operators (UNEP, 2005). Award schemes are helping, such as Green Globe 21 and Blue Flag. The prestigious Marine Art Center Co has awarded Managaha Island and Grotto: Managaha Island as the best place for snorkeling, and the Grotto as the second best diving site (Saipan Tribune 3/29/2005).

As shown in Table 4.8, half of the activities undertaken by visitors are marine-related (e.g. water skiing, fishing). Of those activities 51% directly relate to the coral reef, (e.g. diving, snorkeling, participating in the submarine and/or glass bottom boat). The trip to Managaha Island is the most frequent mentioned activity by the interviewed tourists (69%). Note however that 25% of the respondents did not undertake any activity at all.

Table 4.8 Activities

Rank	Activity	Share	*Rank*	Activity	Share
1	Managaha Island	69.0%	*11*	Parasailing	8.5%
2	Other water sports	20.5%	*12*	Beach resorts	6.5%
3	Scuba diving	17.5%	*13*	Fishing	5.0%
4	Island tour	17.5%	*14*	Tinian day trip	4.5%
5	Snorkeling	17.5%	*15*	PIC day tour	4.0%
6	Dinner cruise	17.0%	*16*	Sea-walker	4.0%
7	Nature/ hiking/ etc	16.5%	*17*	Glass bottom boat	3.0%
8	Jet skiing	16.0%	*18*	Sky-diving	2.5%
9	Sirena submarine	13.0%	*19*	Rota day trip	1.5%
10	Casino	11.5%	*20*	Water skiing	1.5%

On average, visitors to Saipan get involved in 1.8 activities outside the standard package (see Figure 4.2). This relatively low number is also due to the limited time that visitors stay on the island. In fact, 28% of respondents do not undertake any activities while 23 % only undertake one activity during their stay. According to the Market Research & Development, Inc. (2003) around one-third of Japanese visitors purchased an optional tour in the CNMI; the most popular tour being the trip to Managaha Island. Only 5% of Korean visitors went to Managaha Island, but nevertheless rated this trip as the most satisfying optional tour.

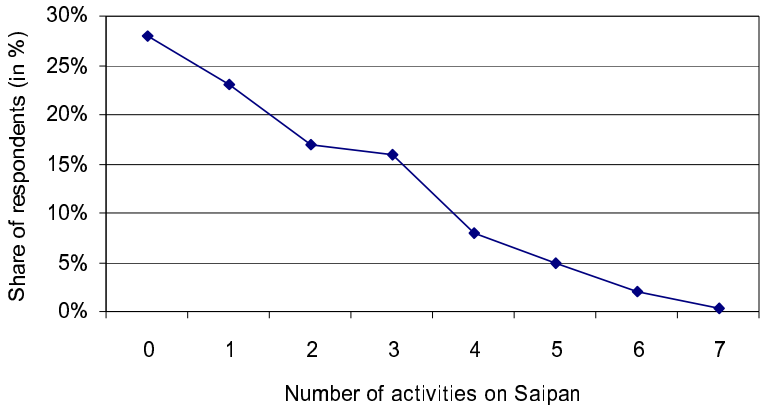

Figure 4.2 Level of activities/tours by visitors to Saipan

Of those respondents in the CEEC survey who visited one of the protected areas, most visited or participated in an activity at Managaha Island (81%) and a few visitors went to Laolao Bay (6.5%) and Grotto (12%). This is confirmed by other information sources. 350,000 people visit Managaha Island each year and pay around $60 for a daytrip (Saipan Tribune, 8/9/2000). The other popular MPAs receive much fewer visitors. According to the survey, Laolao Bay attracts only 6.5% of the visitors to Saipan.

The Saipan Tourist Exit Survey also investigated the level of satisfaction of the different activities. Respondents were asked to rate each activity between 3 (very satisfactory) and –3 (very disappointing). The scores of the most important activities are shown in Table 4.9. The respondents rated jet skiing and scuba diving as the most satisfying activities.

Table 4.9 Satisfaction score of several island activities

Satisfaction island activities	Rating on satisfaction (-3 to 3)	Satisfaction score
Jet skiing	2.61	Very satisfied
Scuba diving	2.51	Very satisfied
Island tour	1.93	Satisfied
Shopping	1.77	Satisfied
Marine sports	1.67	Satisfied
Tinian day trip	1.61	Satisfied
Cultural show	1.55	Satisfied
Casino	1.45	Okay
Golfing	1.37	Okay
Dinner cruise	1.03	Okay

Source: Saipan college student tourism exit survey

The main focus of this study is to determine the economic importance of reef-related tourist activities. Table 4.10 shows a first estimate on the basis of the outcome of the CEEC tourist exit survey. The column 'Activity by visitor' shows the percentage of visitors interviewed who undertook that specific activity. Note that this survey is a snapshot, to place this data in perspective the Korean visitor profile of 2003 shows that 3.2% of the Korean visitors come to Saipan especially to dive and the Japanese visitor profile shows that 13.8% of the Japanese visitors come to Saipan to dive. The Saipan college student tourist exit survey shows that 12% of the visitors mentioned scuba diving

as the motivation to come to CNMI. The price range per activity is derived from the data collected through a business survey executed by this study on Saipan; the average price per dive on Saipan is $50.46 with a range from $20 to $70.

At the moment, there are 48 dive companies on Saipan and one on Rota (with an application pending for a second dive company on Rota). Of the 48 diving companies two-third are Japanese owned while one-third is owned by Korean and Chinese operators. (Personal communication, The NMDOA Vice-President Hitoshi Yamaguchi 2005). The number of divers per company vary from 30 to 7,200 customers. In this study, we estimate that the foreign visitors make around 200,000 dives per year. The explanation of the calculated number of dives is provided in Section 5.5.

Table 4.10 Estimation of revenue of several watersport activities

Watersports °	Activity by visitor [1] (%)	Average price per activity [3] (USD)	Estimation of revenue per activity [2] per year (USD)
Scuba diving	13.3 %	20 – 70	1,312,500 – 4,593,750
Snorkeling	13.3 %	20 – 35	1,312,500 – 2,296,875
Jet skiing	12.0 %	25 – 45	1,500,000 – 2,700,000
Para-sailing	6.4 %	35 – 85	1,115,625 – 2,709,375
Sea/aqua walker	3.0 %	60 – 75	900,000 – 1,125,000
Other*	15.4 %	20 – 60	1,537,500 – 4,612,500

° Note that this table does not comprehend all watersports activities, for example a ride with a glass bottom boat and submarine are not taken into account.

1 Data derived from Tourism Exit Survey executed by CEEC 2004.

2 For the calculations it is assumed that 500,000 visitors arrive at Saipan each year.

3 Derived from data collected through business survey on Saipan.

* Other watersports activities are wakeboarding, windsurfing, kayaking, riding a banana boat, and renting a hobby cat. The price of those activities varies from $ 20 till $ 60.

According to the NMDOA Vice-President Hitoshi Yamaguchi there are two kinds of divers; the "economy" customers and the "first class" customers. The “economy” divers are less environmentally aware than the “first class” divers and they are careless divers (destroying corals while diving). The " first class " divers have a more professional attitude towards the coastal habitat and are more careful when diving. This observation of Mr. Yamaguchi is confirmed by the literature. For example, Burke (2004) reports that scuba divers, who look for high-quality coral reef habitats, generally have a higher willingness to pay for healthy coral reefs and they tend to spend more money during a holiday then non-divers.

Policy makers in CNMI acknowledge the concerns expressed by Mr. Yamaguchi. For example, Mr. Steve Tilley, Deputy Director of the Coastal Resources Management Office, states that his office is working together with the MVA and the dive operators on the development of a program to promote diving safety and getting divers to use reef-friendly dive practices.

The literature also provides evidence of the positive impact of educating divers and snorkelers. As part of the economic analysis of Marine Protected Areas in the Main Hawaiian Islands, Van Beukering and Cesar (2004) estimated the educational spillover of properly instructing and educating snorkelers and divers. The underlying idea of the educational spillover is that education not only benefits the site providing the educational

services, but also prevents physical damage to other reefs visited by the educated divers and snorkelers. The estimate of net present value of the educational overflow for Hawaii is in the range from $22 million to $29 million (with a discount rate of 3% and a period of 25 years). For Saipan, the level of educational spillover is significant for Managaha Island because the majority of the visitors visit this island after which they explore other reefs in CNMI.

4.5 Retention issue

Many countries encounter difficulties in retaining revenues generated by tourism. This is especially the case for income generated by protected areas. Often, the income a country retains does not revert to protected areas and nearby residents (Lindberg, 1991). Also funds spent purchasing imported goods to support ecotourism are known as leakages (Boo, 1990). It is estimated that in developing nations 55% of tourism revenues leak out of local economies and return to developed nations (Frueh, 1988). In the Caribbean, it is estimated that 30% to 50% of the income generated by tourism leaks back to developed countries, via foreign air carriers, hotel owners and suppliers of imported food and beverages (UN Atlas of the Oceans). Another example is Nepal, where it is estimated that less than 10 percent of income from trekking tourists is retained. A private company and an NGO are attempting to minimize leakage and retain 50% of the earnings in the village by organizing special tours to some villages. Those tours and additional features, such as souvenir shops and other businesses in the hotel and catering industries are owned and operated by local people (Prakash 2002).

Leakages occur through imports of goods and services, by tourism income from expatriate labor (arising from domestic skills shortages), and retention of profit by foreign-owned tourism enterprises. Typical examples are the Dynasty Hotel and Casino on Tinian, which are owned and operated by Chinese investors and employees. In 2002, there were 151 accommodation and food services establishments on CNMI of which only 28 were owned by CNMI born citizens (U.S. Department of Commerce, 2004).

One of the findings of the tourism exit survey by CEEC is that 60% of the tourists visiting CNMI arrive on package tours, which includes airfare, airport transfers, hotel, meals, and in some instances local transportation and optional tours. In 2003 around 60% of the Japanese visitors came by full package arrangements and around 40% of the Korean visitors (Korean and Japanese Visitor Profile 2003). This could mean that the actual economic impact of package tourism may be smaller than full expenditure estimates suggest. Also, non-resident workers send substantial amounts of money back to their home country as remittances or hold it in savings accounts that are subsequently withdrawn when the guest workers leave island. The same holds, though to a smaller extent, for the other uses.

The Tourism Expenditure Retention Survey executed by CEEC/ARC shows the retention of tourism spending at 13 local owned businesses and 2 foreign owned businesses (See Table 4.11). The purpose of this survey was to obtain a general understanding of the retention of tourism expenditures within the CNMI economy. Approximately 35 businesses with a strong dependence upon tourist traffic were approached. Many of the businesses were located in Garapan, the central tourism district. However, when owners were found to be residing off-island, staff felt uneasy and

unwilling to provide estimations, although respondents were assured of confidentiality. This biased the data set towards locally owned businesses.

Respondents were asked to estimate where (on-island or off-island) annual revenues were spent. Examples of off-island expenditures included; inventory replacement through off island suppliers, debt service to off-island lenders, dividends and profit taking by off- island owners, insurance, professional services (legal, management, etc), advertising off- island. Examples of on-island expenditures included; utilities, wages, taxes, services, debt service, professional services, suppliers etc. located within the CNMI. This number would be annual revenue less off-island expenditures.

Table 4.11 Overview of retention of tourism spending at 15 tourism-related companies based on a survey conducted in July 2005

Type of Business	Annual Revenue Spent Inside the CNMI (in %)	Annual Revenue Spent Outside the CNMI (in %)	Ownership
Hotel No. 1	95	5	local
Hotel No. 2	80	20	local
Hotel No. 3	90	10	local
Hotel No. 4	75	25	local
Hotel No. 5	95	5	local
Average	*87*	*13*	
Restaurant No. 1	100	0	local
Restaurant No. 2	95	5	local
Average	97.5	2.5	
Dive Shop No. 1	90	10	local
Dive Shop No. 2	95	5	local
Average	*92.5*	*7.5*	
Internet Café	95	5	local
Average	*95*	*5*	
Tour Co. No. 1	70	30	off-island
Tour Co. No. 2	60	40	local
Average	*65*	*35*	
Retail Est. No. 1	70	30	local
Retail Est. No. 2	60	40	local
Retail Est. No. 3	50	50	off-island
Average	*55*	*45*	

Note that the ownership data should be considered carefully as some owners own business in other countries and may live in several locations.

The retention issue is also relevant for the snorkeling and diving industry on Saipan. Also for this sector, we have limited information. From the interview with Hitoshi Yamaguchi, we learned that 48 dive companies operate on Saipan. Mr Yamaguchi is aware of 19 Japanese owned companies and 7 to 8 Korean and Chinese-owned companies. If we assume that the remaining companies are not necessarily locally owned, we can conclude that around two-third are Japanese owned and one-third is Korean/Chinese owned.

In summary, it is difficult to conclude that more tourist revenues are leaking away through the tourist industry on Saipan than in other tourist destinations. Data limitations constrain us in drawing accurate conclusions in this direction. However, even if capital is

flowing abroad, this is not necessarily a negative phenomenon. For the tourist industry to come to full development and in turn provide income multiplier effects of tourist expenditure in CNMI, foreign investment is essential. With an undiversified economy, little investment capital, and shortages of skilled human resources, leakages are a “one-time price to pay" to get started in tourism, maintains Pierre Encontre, an economist with UNCTAD. Successful examples of reducing leakages are found in Nepal and Tanzania. According to Drumm (1991) leakages in conventional tourism, such as beach holidays are naturally higher than in ecotourism. If the CNMI government prefers to ensure revenue retention, however, this can be achieved by regulating foreign investment and by encouraging local investment and employment in lodging, guide services, and other ventures.

5. Total economic value

5.1 Introduction

The main goal of this study is to determine the economic value of the marine ecosystems of Saipan. At the core of this economic value are the various coral reef ecosystem functions, which translate into reef-associated goods and services (benefiting Saipan's society). As shown in Table 5.1, each of these goods and services has associated economic benefits. *Goods* provided by coral reefs can be sub-divided into renewable resources (fish, seaweed, etc.) and non-renewable goods (such as sand mined from reefs etc.). The *services* provided by coral reefs are categorized in general into: (i) physical structure services (e.g. coastal protection); (ii) biotic services, both within ecosystems (e.g. habitat maintenance) and between ecosystems (e.g. biological support through mobile links); (iii) bio-geo-chemical services (e.g. nitrogen fixation); (iv) information services (e.g. climate record); and (v) social and cultural services (e.g. aesthetic values, recreation).

Table 5.1 Goods and services of coral reef ecosystems

Service	Products
	Goods
Renewable resources	Seafood products, raw materials and medicines, other raw materials (e.g. seaweed), curio and jewelry, live fish and coral collected for aquarium trade
Mining of reefs	Sand for buildings and roads
	Services
Physical structure services	Shoreline protection, build-up of land, promoting growth of mangroves and sea grass beds, generation of coral sand
Biotic services (within ecosystem)	Maintenance of habitats, biodiversity and a genetic library, regulation of ecosystem processes and functions, biological maintenance of resilience
Biotic services (between ecosystems)	Biological support through 'mobile links', export organic production etc. to pelagic food webs
Bio-geo-chemical services	Nitrogen fixation, CO_2 / Ca budget control, waste assimilation
Information services	Monitoring and pollution record, climate control
Social and cultural services (including tourism)	Support recreation, tourism, aesthetic values and artistic inspiration, sustaining the livelihood of communities support of cultural, religious and spiritual values

Source: adapted from Moberg & Folke (1999)

The goods and services discussed above have associated economic values. The value of the sum of compatible uses of these goods and services together form the Total Economic Value (TEV) of coral reef ecosystems (e.g. Spurgeon and Ayleward, 1992). This TEV can be calculated for a specific area or for alternative uses (e.g. preservation, tourism, multiple use etc.). In the coming sections, we demonstrate the calculation of the TEV of coral reefs on Saipan.

5.2 Methodology

Economic valuation is a tool that nowadays is commonly used to evaluate the economic importance of coral reefs to society. The methods vary, depending on the type of attributes valued. In this section we briefly introduce the concept of economic valuation of coral reefs by describing i) values, ii) goods and services, and iii) valuation techniques applied in this project. A more elaborate explanation of the methodological background of coral reef valuation can be found in Cesar *et al.* (2000) and Gustavson *et al.* (2000).

Value types

There are many ways of looking at the value of coral reefs. In this Section we will describe four of these. These include:

- Market and non-market values
- Use and non-use values
- Producer and consumer surplus values
- Economic and financial values

Market and non-market values

A fundamental way to categorize the economic value of coral reefs is the distinction between market and non-market goods. The value of market goods, such as the price of fish or seaweed, can be directly observed from markets in the economy. These values are therefore relatively easy to value in monetary terms. Non-market goods, such as beach visits and snorkeling at a coral reef, are not directly traded in the market. Similarly non-market services from coral reefs, such as coastal protection and sequestration of carbon dioxide, are generally not directly reflected in market prices. Non-market goods and services therefore require special valuation techniques to determine its economic value. Throughout this study we will attempt to distinguish between market and non-market goods.

Use and non-use values

As shown in Figure 5.1, the TEV of coral reef ecosystems can be sub-divided into *use* and *non-use* values. Use values are benefits that arise from the actual use of the ecosystem, both directly and indirectly. Direct use values come from both extractive uses (fisheries, pharmaceuticals, etc.) and non-extractive uses (tourism). Indirect use values include, for example, the biological support that reefs provide in the form of nutrients. Another example is the coastal protection value that coral reefs provide. Non-use values consist of option, bequest and existence values. The option value can be seen as the present value of potential direct and indirect uses of the coral reef ecosystem. An example is the potential for deriving a cure for cancer from biological substances found on reefs. Bio-prospecting is a way of deriving money from this option value. Related to the option value is the so-called quasi-option value, capturing the fact that avoiding irreversible destruction of a potential future use gives value today. The bequest value is related to preserving natural heritage for generations to come. The large donations that are given to environmental NGOs in wills are an example of the importance of the bequest concept. The existence value reflects the idea that an ecosystem is of value irrespective of whether it is used or not.

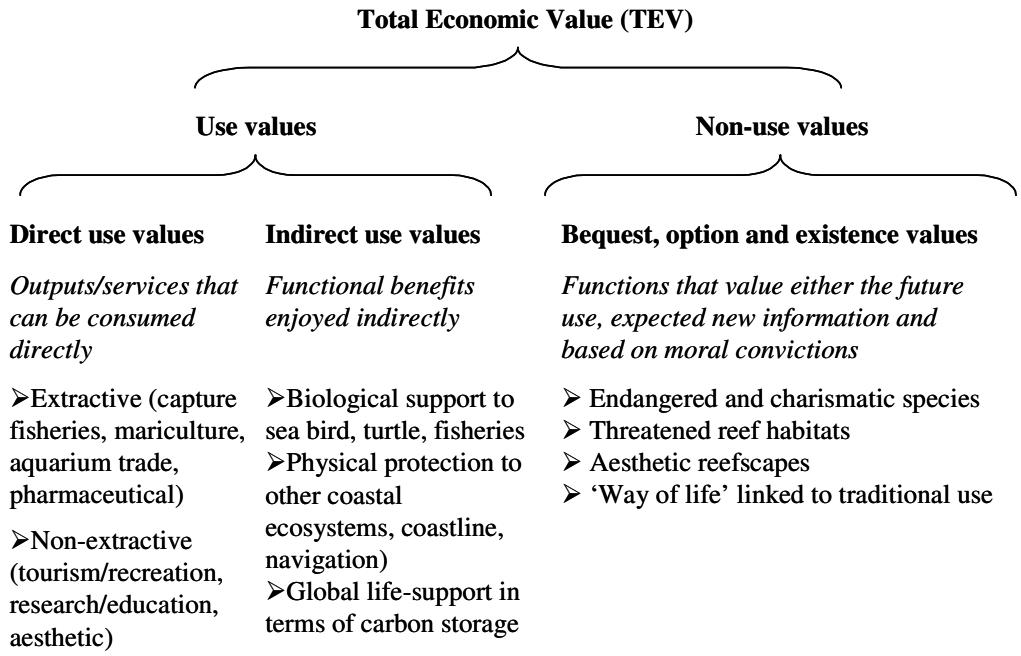

Figure 5.1 Sub-division of the total economic value of coral reefs

Consumer and producer surplus

From a theoretical perspective, the Total Economic Value (TEV) is defined as the sum of the producer and consumer surplus. To illustrate the meaning of these terms, an example for reef-related recreational benefits has been shown in Figure 5.2. The *supply curve* is positively sloped because more dive and snorkel trips will be supplied if the revenue is high. After all, the producers can make more profit at higher prices, and therefore provide more "products". The *demand curve* is negatively sloped because the demand is high at low prices and will drop if the prices increase. Demand and supply will match at the equilibrium indicated by ***e***, which is a combination of price p and q number of tourist that will go snorkeling or diving.

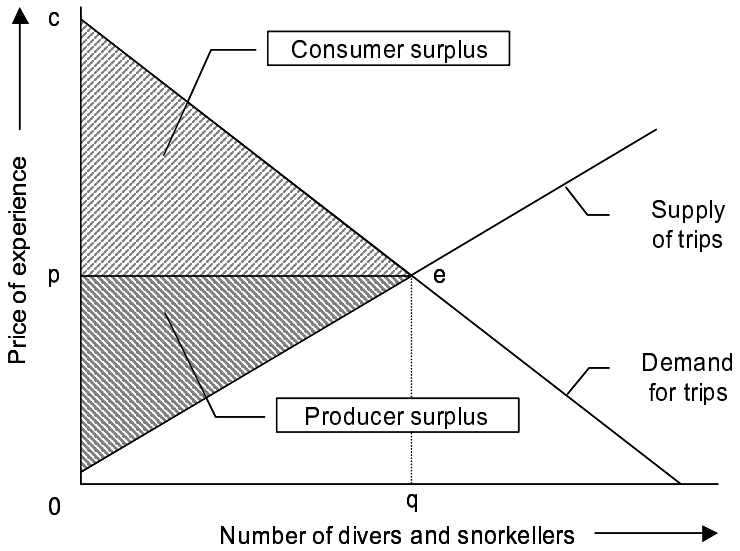

Figure 5.2 Conceptual composition of the recreational benefits

Both producers and consumers benefit more from this situation than in a situation where no trips were sold. In fact, the consumers as a group would have been willing to pay as much as the area ***ceq0*** but instead only are paying as much as ***peq0***. The *consumer surplus* in this situation is the shaded triangle ***cep***. You can also interpret the consumer surplus as the "profit" that the consumers make. A similar situation holds for the producers who would have been willing to offer their services at a value equal to the area ***qe0***. Instead they receive as much as ***peq0*** of revenues. In other words, the *producer surplus* is equal to the shaded triangle ***pe0***, indicated as the producer surplus. The recreational value of coral reefs on Saipan is equal to the sum of the consumer and the producer surplus.

To calculate the consumer surplus, (i.e. the amount the visitors would have been willing to pay (WTP) in addition to the actual payment to enjoy the Saipan reefs), we applied benefit transfer from studies conducted in other countries. Calculating the producer surplus is a more complex issue. Formally, one would need to ask producers their WTP to produce an additional service or good. However, because such estimates are not available for the marine-related industry on Saipan, we calculate the producer surplus by multiplying the value added of a marine related good with the number of goods sold. This implies that we aggregate the financial value added of the direct and indirect expenditure related to marine activities. The actual expenditure directly related to snorkeling or diving experience includes entry fee, hiring of mask and fins, bus fare etc. The expenditures indirectly related to the marine experience such as hotel costs and travel costs.

Financial and economic values

It is important to understand the difference between the financial and the economic value of coral reefs. The *financial* value concentrates on the cash flows that are linked the use values of coral reefs. This involves the value added from fisheries, the tourist industry and the dive and snorkeling operations on Saipan. It is common to also account for the secondary financial effects of these revenues on the economy of Saipan: the so-called multiplier effect. This accounts for the effect that expenditures in the coral reef related industry have on other sectors in the CNMI economy. The *economic* importance of coral reefs, the TEV, includes both market and non-market effects and therefore has a broader interpretation of value. Another difference between the economic and the financial value is the fact that the multiplier effect is not accounted for in the TEV (see Figure 5.3). In this study, the prime focus is on determining the TEV.

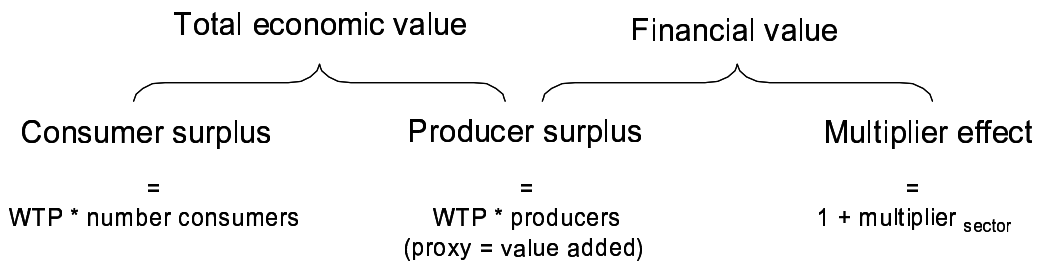

Figure 5.3 Difference between economic and financial value

Selected goods and services

Resource and budget constraints call for a selection of the most important goods and services for actual economic valuation, and thereby inclusion in the TEV of Saipan's coral reefs. Therefore, the following goods and services were quantified to obtain a 'lower boundary' estimate of the TEV:

- *Tourism*: Tourism is big business on Saipan. Although not all tourism depends directly on coral reefs, coral reefs often form an important marketing tool to attract foreign visitors. Therefore, much coastal tourism depends to an extent on the quality and quantity of the coral reefs on Saipan.
- *Diving and other direct recreational uses*: The recreational use of coral reefs relates to reef-related activities (such as diving, snorkeling, submarines, and surfing) enjoyed by both tourists and residents.
- *Fisheries*: Commercial, subsistence and recreational fishing are all important for Saipan's economy. Traditionally, fishing has been a central activity within local communities, with an important cultural value.
- *Coastal Protection*: Coral reefs act as wave breakers and thereby fulfill an essential function in terms of coastal protection. The valuation of the impact of decreased protection (due to a variety of threats) depends on current and/or potential economic activities in the area.
- *Amenity value and property value:* The beautiful views of shallow coastal waters from beachfront properties suggest that part of the amenity value of these properties can be attributed to the presence of coral reefs. Degradation of the reefs makes beachfront properties less attractive, reduces occupancy rates in hotels, etc. (Gustavson *et al.*, 2000).
- *Cultural services*: Native Saipan communities have traditionally had a special cultural attachment to the ocean and its reefs. Most residents share these views to some extent; coral reefs and the sea are an important part of daily life on Saipan. Though not very tangible, this is a clear 'service' that reefs provide to residents.
- *Biodiversity*: Saipan is home to a great number of endemic species and many professionals are attracted by this biodiversity. For example, some pharmaceutical companies are interested in exploring bio-prospecting. In this study, we will attempt to determine a specific value of biodiversity through estimates of expenditures by government agencies and NGOs on coral reef research on Saipan.

Valuation techniques

For the economic valuation, these different benefits need to be quantified and put in monetary terms. A host of valuation techniques is available to value the goods and services provided by the coral reef ecosystems. Standard techniques in micro-economics and welfare economics rely on market information to estimate values. However, for most externalities inherent to environmental issues, standard techniques such as using market prices cannot be employed.

Three general categories are identified: (i) generally applicable techniques that use the *market directly* to obtain information about the value of the affected goods and services or of direct expenditures; (ii) *revealed preference* methods that calculate external benefits indirectly by using the relationships between environmental goods and

expenditures on market goods; (iii) *stated preference* methods which ask individuals about their willingness to pay (WTP) for the environmental good directly (by using structured questionnaires). WTP is defined as the maximum amount of money a person is willing to pay to obtain a good or service.

Because of the wide range of economic values related to coral reefs on Saipan, a number of valuation techniques are applied in this study. The general procedure followed in these valuation techniques is shown in Figure 5.4. First, the most important goods and services provided by the coral reefs of Saipan are identified. Second, the service is quantified in physical terms (e.g. number of tourists benefiting from the reefs, fish catch in kg). Third, a monetary value is attached to the different goods and services. The valuation techniques used in this step are more elaborately addressed in later sections. Finally, the individual values are aggregated into the Total Economic Value (TEV).

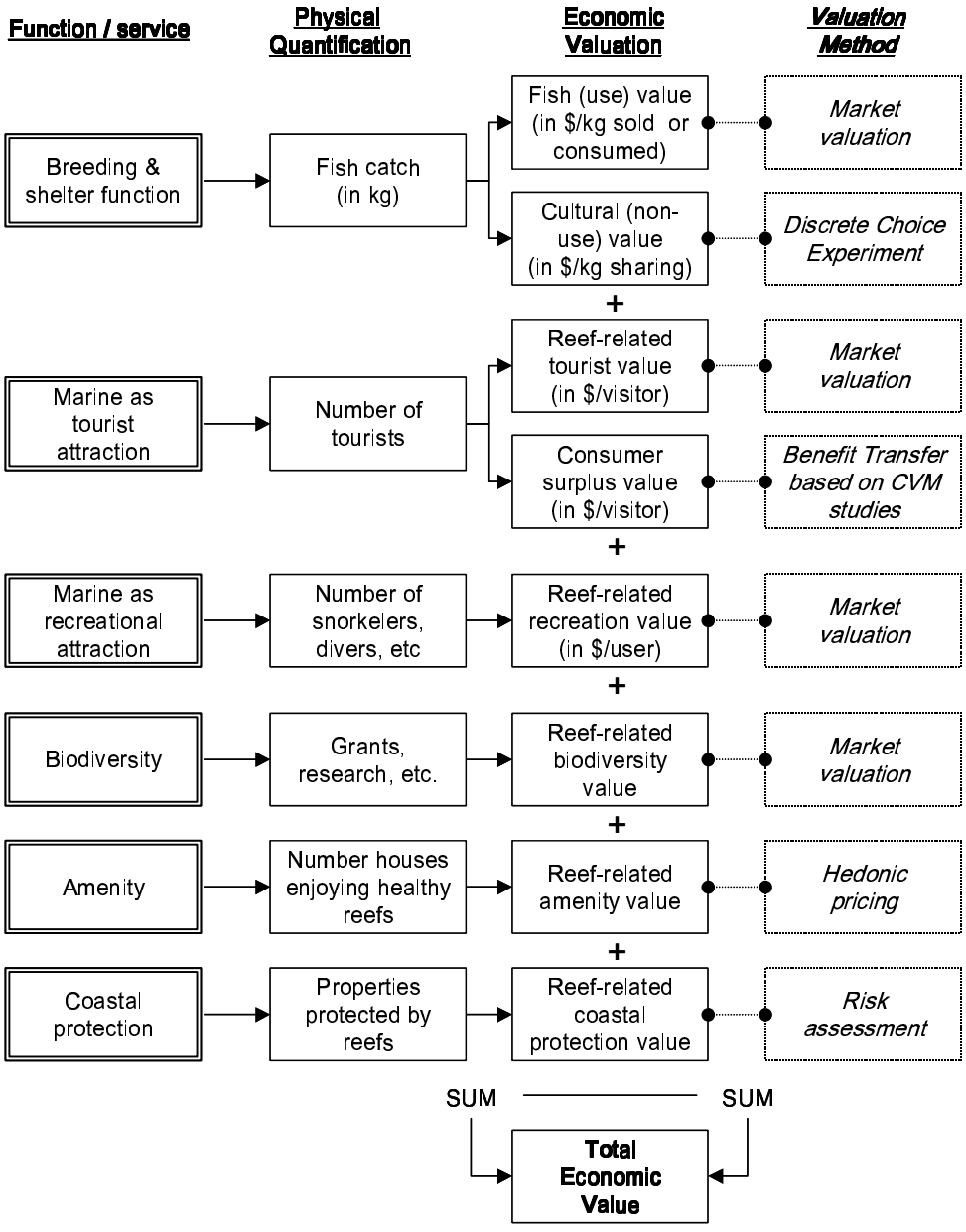

Figure 5.4 Framework of economic values and valuation techniques applied to determine the Total Economic Value of the coral reefs of Saipan

5.3 Fisheries

Fish have long been a very important food source and the primary source of protein for the inhabitants of Saipan. Historically most fishing was done for subsistence, providing an ample supply of fish. The Japanese period, from 1914 to 1944, forms an exception, when more than three and a half million kilos were landed each year, primarily as export product for the Japanese market (Radtke and Davis, 1995). After World War II, fishing on Saipan returned to the subsistence model. Over the past decades, a gradual change has taken place from an almost totally subsistence based fishing fleet to the modern mix of subsistence, commercial and recreational fisheries.

Reef fish continue to represent a significant portion of the local diet. They are preferred by the local community, as opposed to the large amount of short-term tourist visitors, often of Japanese origin, who prefer pelagic fish. The growth of the local community has increased pressure on the reef fish stocks, leading to worries on over fishing this source (Radtke and Davis, 1995). Despite this pressure on fish stocks, the reefs of Saipan provide an important habitat for fish. Generally, reefs create significant opportunities for feeding, breeding and refuge from predation for both fish and invertebrates. As a result, reef complexity is directly linked to reef biomass: reef habitats with greater structural complexity have higher primary productivity (e.g. Adey & Steneck 1985). This link between physical complexity of the reef substratum and fish populations is confirmed by Luckhurst and Luchhurst, 1978; Gladfelter *et al.,* 1980; Carpenter *et al*., 1981; Sano *et al.,* 1984; Roberts and Ormond, 1987; Hixon and Beets, 1989; and Galzin *et al.,*1994.

To determine the value of reef-related fisheries, both the direct and indirect value of reef-fishing should be taken into account. The indirect value refers to the cultural and recreational importance of fishing on Saipan. This valuation exercise is described in the choice modeling section (see Chapter 3). The direct value of reef-related fisheries refers to the market value of the fish catch provided by the coral reefs of Saipan.

Market Value

Data on fishing methods used on Saipan is hard to come by. According to the Fishery Statistics of the Western Pacific (SWFC), the Division of Fish and Wildlife (DFW) collects data from vendors who purchase fish catch from fishermen on Saipan. This data collection system is based on voluntary reporting and includes the following type of information: date, weight (pounds), buyer's name (dealer), price per pound, seller's name, value, species and invoice number (SWFC, 2001). A detailed description of the collection method used in the voluntary vendor invoice system is lacking, though aggregate catch per unit effort (CPUE) data is available (Starmer et al., 2005)[24]. An extensive search for good quality data on this issue produced only limited information. We fill this data gap by using fishery data generated by the household survey (see Section 2.6).

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[24] Starmer (ed.) Contributors: Clarissa Bearden, Russell Brainard, Tina de Cruz, Ronald Hoeke, Peter Houk, Stephani Holzwarth, Steve Kolinski, Joyce Miller, Robert Schroeder, John Starmer, Molly Timmers, Michael Trianni, and Peter Vroom (2005) The State of Coral Reef Ecosystems of the Commonwealth of the Northern Mariana Islands.

To determine the direct value of reef-related fisheries, all fishing activities concerning reef related catch need to be determined. For this purpose, the data sources of DFW were analyzed. Each year DFW conducts interviews with fishermen at the port to extract data on catch, value and species caught, amongst others. These data are then used to extrapolate total annual catches on Saipan. The DFW uses an estimation of total reported catch to compensate for non-participating dealers and sales directly to consumers. A value of 80% was used as an annual percent coverage factor for all years from 1981 to 2003. A value of 55% was used as a percent coverage factor for 2004 and 70% was used for 2005 (Pacific Islands Fisheries Science Centre (PFISC), website).

The result of this method for the period 1981-2004 is shown in Figure 5.5.The total commercial landings averaged 192 tons over the past 23 years. With on average 68 tons of reef-associated catch, reef fish account for an average 34% share total fish catch.

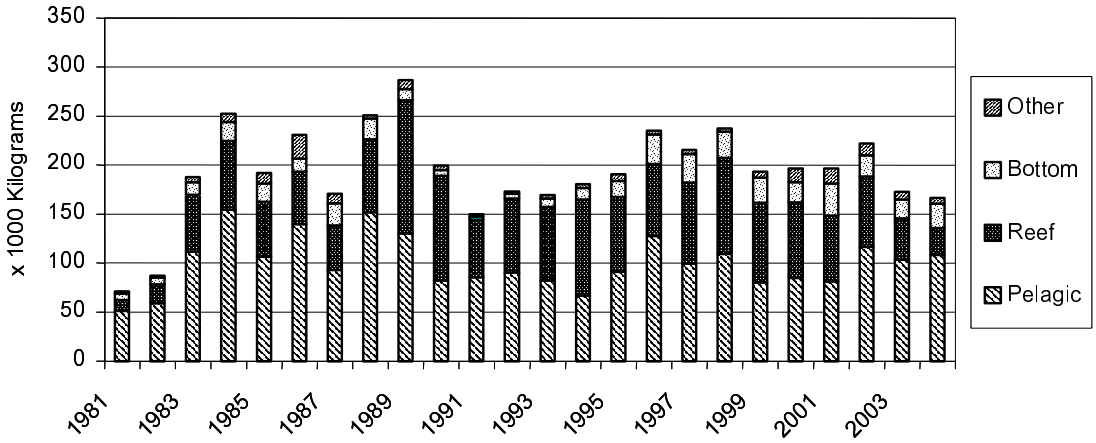

Figure 5.5 Total fish catch specified per category (in metric tons)

Whereas total catch remains reasonably constant over the years (with even less variation in the last 13 years then the period before 1991), reef associated catch has declined markedly, both in absolute and relative terms. This is depicted in Figure 5.6. Over the last 5 years the average catch amounts to 57 tons per year, or 29% of total fish landings. Part of this decline could be attributed to the recent ban on fishing methods like gill netting and scuba spear fishing. An alternative explanation of the decline in catch is that stocks are gradually being depleted. Based on the knowledge available to us, it is impossible to determine which factor (i.e. the decline of banned fishing methods or the decline in fish stock) is the dominant factor in explaining the decline in fish catch.

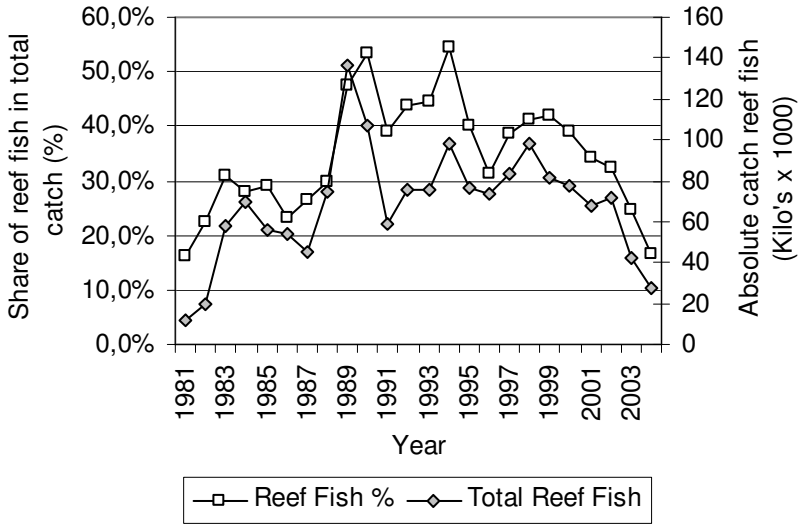

Figure 5.6 Reef Associated landings, according to DFW data

When reviewing catch per unit effort (CPUE) data for Saipan, some patterns become visible (see Figure 5.7). The time series available for CPUE data runs from 1983 until 2003. Unfortunately, the metric used to measure unit effort for the Saipan CPUE data is not specified. The data shows a notable decline from a peak efficiency in 1989, with CPUE declining by a factor of three in the following 14 years (Starmer *et al.*, 2005).

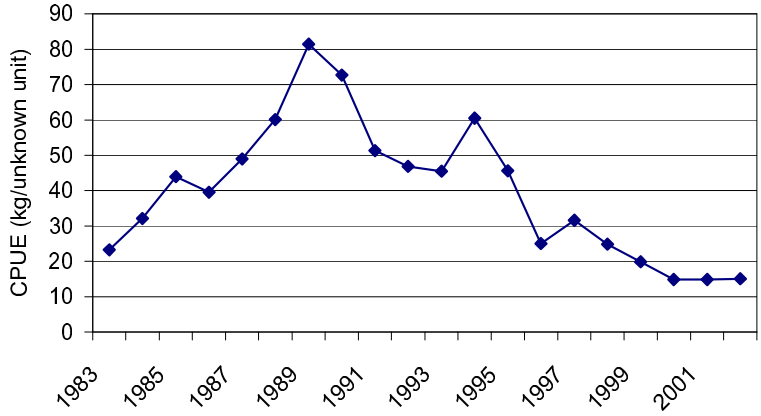

Figure 5.7 Catch per unit effort for fishing on Saipan (in kg/unknown time unit)

The market for reef fish seems to have increased on Saipan. Part of this increase finds it roots in the growth of the tourism and garment industries until the mid nineties. With the influx of new people comes larger demand for local fresh fish, so the market continues to expand. Potentially, the decline in CPUE in combination with an increasing demand for fish may be reflected in higher fish prices. Figure 5.8 shows how average fish prices on Saipan have gradually increased over the last 23 years. The last 5 years have seen a relatively level price per kilo of around $5.11 per kilo fish. The price for reef fish lies somewhat higher, averaging $5.92 per kilo over this period. It should be noted that rapidly increasing reef fish imports into Saipan, particularly after 1998, have likely offset the effect of local fishery decline on prices (Starmer et al., 2005).

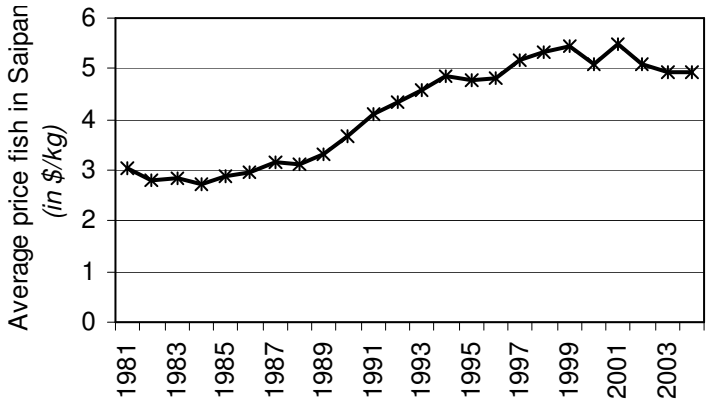

Figure 5.8 Price development of total fish catch on Saipan (US$ per Kg Fish)

To valuate the direct economic value of reef fishery on Saipan, several corrections need to be applied to the data. First, the landing data from DFW needs to be scrutinized. As mentioned, DFW's principal method of collecting domestic commercial fisheries data is a dealer invoicing system, sometimes referred to as a "trip ticket" system (WPacFIN & DFW, 2005). The data gathered is extrapolated to the whole of CNMI, with an assumed 90% share for Saipan. Another assumption made by DFW is that an average of 90% of all commercial landings is reported. It follows that Saipan landing data is estimated at 80% of total CNMI landings (the last 2 years have seen a lower estimated reported share of total landings, DFW corrected for this already). Since we are concentrating on Saipan, we will have to multiply all landing data with a correction factor of 0.9 to cover Saipan only.

Secondly, according to Radtke and Davis (1995), most of the subsistence fishery is unaccounted for. They suggest a maximum correction factor of 1.7 to compensate for this, but this may be somewhat on the high side, especially since data gathering methods have been improved over the last decade. We will consequently use this as a maximum correction and use a factor of 1.3 as a more conservative estimate. The most conservative estimate is one without any correction for subsistence catch.

Taking these points into account, what follows is straightforward. The direct value of fish can be calculated according to the cost price of fish, which in turn is assumed to be around 90% of the market value of fish sold on Saipan. Based on the most recent 5-year average price reported above, we adopt a price of $5.92 per kg of reef-associated fish. Taking the 5-year average of 57 tons of reported reef landings leads to a minimum direct value of $305,000 (i.e. 90% * 57 tons * $5.92). Likewise, we can now calculate the value using both conservative and extreme correction factors for subsistence fishing leading to $ 425,000 and $ 555,000, respectively. The direct market value of reef-related fisheries over the years is graphically depicted in Figure 5.9.

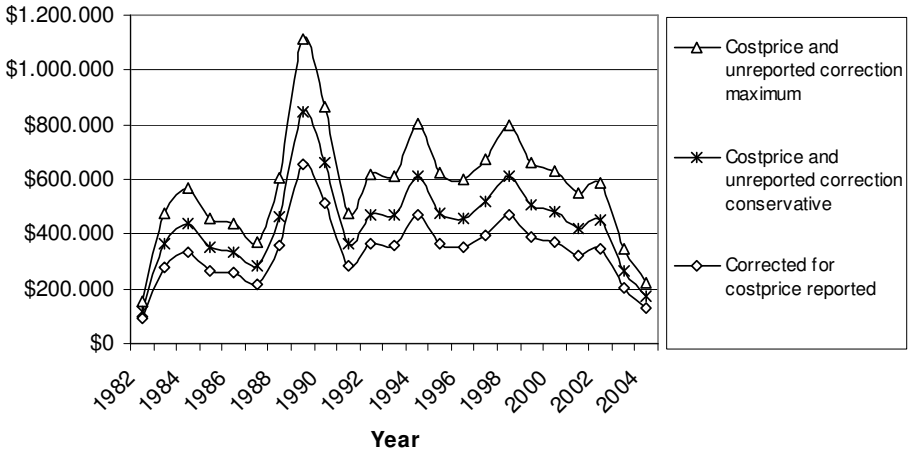

Figure 5.9 Direct Value of reef fishery over the past 22 years

Non-market value

Another important value of fishery activities on Saipan is the non-market value of these mostly cultural and recreational activities. This non-market dimension of fishing stands for a number of services, such as the bond with fellow fishermen, the tradition of fishing, the exposure to the ocean and nature in general, and the possibility of sharing fish with friends and family.

An attempt has been made to determine the cultural value of fisheries on Saipan by means of a choice experiment (see Chapter 3). Due to complications with specific cultural data retrieved for fisheries amenities in the choice experiment, it has become more difficult to determine significant cultural values.[25] This does not imply, however, that these values do not exist on Saipan. After all, a similar experiment with high quality data revealed highly significant and meaningful cultural values in Guam (i.e. $43.06 per household per year). Therefore, we will adopt the Guam estimate and modify the value for Saipan conditions. Because the level of the cultural value is partly explained by the level of income of the respondent, we modify the Guam estimate by the difference in income between Guam and Saipan. In 2000, the per capita purchasing power parity in CNMI and Guam were $12,500 and $21,000, respectively (CIA, 2005). Therefore, we will assume the cultural value to be around $23 per household (i.e. $12,500 divided by $21,000 times $43.06).

The above marginal estimates provide sufficient information to determine an upper- and lower bound value of the cultural (non-market) importance of fishing on Saipan. Given the fact that both variables (i.e. the type of fish caught and the level of sharing of the catch) are determinants of the cultural value of fishing, we can conclude that Scenario 3 is the most conservative estimate while Scenario 2 provides the most optimistic scenario. Given the fact that the number of households on Saipan is 19,705 (see Table 5.2), we can determine the aggregated maximum and minimum value of the cultural importance of fishing. The minimum value is based on the lower estimate of $23 per household in

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[25] As shown in Table 3.2 and Figure 3.2, the attribute "fish catch" did not prove to be statistically significant. Therefore, an economic value for this variable could not be determined.

combination with the assumption that only those families that actively participate in fishing, benefit from fishing and sharing. This minimum value amounts to $208,265. For the maximum cultural value, it is assumed that all households on Saipan benefit from fishing and sharing in combination with the upper bound estimate derived in the choice experiment (i.e. $73.49 per household). This maximum cultural fishing value is estimated to be almost $1.45 million.

Table 5.2 Calculation of the cultural (non-market) value of fishing on Saipan

Variable	Level	Unit
Saipan population (2005)	72,119	People
Household size on Saipan (2005)	3.66	Person per household
Number households on Saipan (2005)	19,705	Households
Minimum fishing household share	0.45	Assuming only fishing households benefit
Maximum fishing household share	1.00	Assuming all households benefit from sharing
Minimum annual value	23.49	US$/household
Maximum annual value	73.49	US$/household
Minimum cultural value	208,265	US$/year
Maximum cultural value	1,448,189	US$/year

5.4 Tourism

Tourist expenditures related to coral reefs extend much further than the direct revenues gained from water sports activities. The presence of clean beaches and pristine coral reefs is a reason in itself for tourists to choose Saipan as their holiday destination, regardless of whether they actually participate in marine-related activities or not. Therefore, calculating the recreational benefits involves much more than simply adding up the generated value of the diving and snorkeling industry. On the other hand, not all revenues generated by the tourist industry are marine-related. To determine the economic tourist value of coral reef-related ecosystems on Saipan we need to calculate the producer and consumer surplus.

Producer surplus

In calculating the producer surplus we multiply the cost price of marine-related tourism with the number of tourist days spent on Saipan. In doing so, we make several crucial assumptions to calculate the producer surplus. First, we only account for the marine-related share of tourist revenues. As explained in the previous section (see Table 4.10), we assume that 29.6% of the reason tourists come to Saipan is because of its marine-related attractions (i.e. aggregation of diving activities [13.3%], snorkeling [13.3%], and sea-walking/glass-bottom boat [3%]). Therefore, as shown in Table 5.3, we begin by discounting the gross tourist revenues accordingly. Second, rather than accounting for the gross revenues of marine-related tourism revenues, we need to consider only the cost price of providing these tourist services. Similar to the fishery calculations, we use the value added of the tourist industry as a proxy for the cost price. Because no information was found on the value added for the various sectors on Saipan, we adopt the levels known for the Hawaiian economy (Cesar *et al.*, 2001).

Table 5.3 Average Compulsion of Spending (in $)

Nationality	Off-island expenditure	On-island expenditure	Total expenditure
Gross expenses [a]	578	440	1017
Marine-related factor	*29.6%*	*29.6%*	
Marine-related value added	171	130	301
Cost price factor [b]	*25%*	*25%*	
Cost price	43	32	75

Sources:
[a] See Table 4.4, Table 4.5 and Table 4.6
[b] Cesar et al., 2001

As shown in Table 5.3, this calculation indicates that for each tourist that arrives on Saipan, the marine-related producer surplus amounts to $75 per visitor. Figure 4.1 shows how, in the last five years, an average of half a million tourists visited Saipan every year. This means that the marine-associated producer surplus of tourism on Saipan amounts to $37.7 million per year.

Consumer surplus

The consumer surplus of marine-related benefits of the tourist industry is defined as the payment that visitors are willing to make for their marine-related experience on Saipan, in addition to the actual expenditures that they already incur during their trip. The common method to measure this WTP is to apply the contingent valuation method or the travel cost method. Because the necessary financial means to conduct an elaborate tourist survey to determine the non-market value of coral reef services to foreign visitors are lacking in this study, we need to use alternative approach to estimate the consumer surplus of the marine-related tourist industry.

The number of coral reef valuation studies has increased rapidly in the last decades. Brander and van Beukering (2005) collected 160 coral reef related studies that contain economic elements. This 'flood of numbers' necessitates the application of research synthesis techniques, and in particular meta-analysis, in order to assess the results of this literature as a whole and identify the key explanatory factors that determine coral reef value. Meta-analysis can be defined as a quantitative analysis of summary indicators reported in a series of similar empirical studies. Meta-analysis extends beyond a state of the art literature review by examining the results of multiple studies in a statistical manner. Proponents of meta-analysis maintain that the valuable aspects of narrative reviews can be preserved in meta-analysis, and are in fact extended with quantitative features (Rosenthal and DiMatteo, 2001). In the case of coral reef valuation, a standardized shadow price can be analyzed, such as the dollar value per year of one km^2 of coral reef area or the willingness to pay (WTP) per coral reef visit.

The above-mentioned database developed by Brander and Van Beukering (2005) is used to extract values for benefit transfer in the Saipan study. From the 160 coral reef-related studies present in the database, 47 studies contain CVM estimates of WTP for recreational use of coral reefs, such as diving and snorkeling. These estimates reflect the additional payment visitors are willing make for the same experience, or in some cases, with the knowledge that the additional payment is used for conservation of coral reefs.

As can be seen in Figure 5.10 the majority of the WTP estimates range between $0 and $10 per person per trip. The median of the estimates is $4.48 and average of the range is $9.23 per person per trip. Knowing that high-income visitors from Japan dominate the Saipan market and that the WTP per person is strongly explained by household income of the visitors, we adopt the average estimate as the proxy for the consumer surplus of coral reef related recreational activities. Adopting the average number of visitors of half a million per year, we estimate the consumer surplus to account for $4.61 million per year.

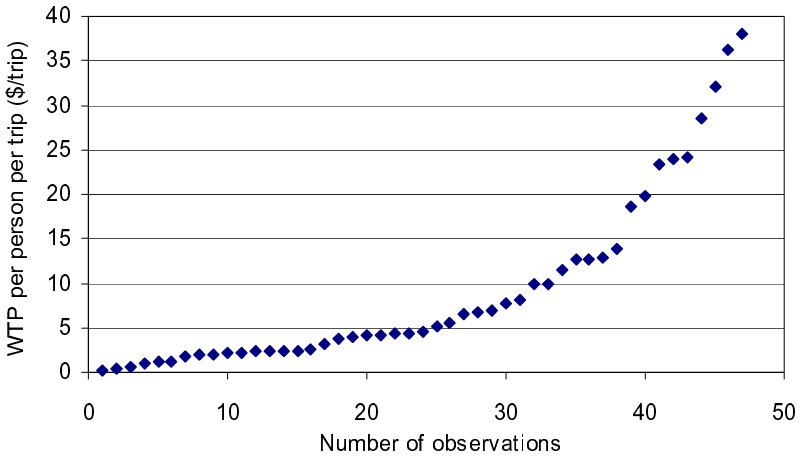

Figure 5.10 Estimations from the literature for the additional WTP for coral reef related recreational activities

5.5 Diving and snorkeling

As mentioned earlier, the main types of ocean-related recreation on Saipan include scuba diving, snorkeling, jet skiing, kayaking and windsurfing. Clearly, these activities generate substantial direct revenues to the Saipan economy. Little is known about the exact extent of these activities on Saipan. In Section 4.4, all available information on the watersports industry was presented. On the basis of this information, we attempt to determine the volume and direct economic importance of the marine-related activities to Saipan. The main emphasis is placed on the diving industry, because its link with coral reef ecosystems is most explicit. Moreover, within the water sports industry, the diving sector is the best documented in terms of volume and values. Therefore, we first calculate the extent of the diving activities on Saipan, after which we extrapolate these findings to other watersports activities.

Quantification of watersports activities

In quantifying the size of the watersports activities on Saipan, two approaches have been followed. First, we estimate the number of active watersports participants top-down (e.g. starting from the total number of visitors to Saipan to arrive at activity numbers). Second, we use estimates from MVA and Tassi tours to generate bottom-up estimates. Finally, we decide which numbers are most useful to apply in this study.

Top-down approach

We used several sources to estimate the numbers of dives that take place in and around the coral reefs of Saipan. It was estimated that the minimum number of dives by foreigners amounted to around 30,000, assuming 3% of the visitors to participate in diving activities for the amount of 2 dives during their stay (see Table 5.4). The maximum number of foreign dives was estimated to be 300,000 dives, assuming 15% of the visitors to dive at least 4 times during their stay. From the various data sources, we concluded that the average number of dives is more likely to be around 200,000 dives by foreign visitors every year. Besides foreign divers, local residents also tend to get involved in diving. The household survey showed that 2% of the households on Saipan actively dive as a leisure activity. Based on our expert interviews, we assume that these local divers dive around 10 times in a year. This results in a total number of dives by local residents of 15,800 (third column of Table 5.4). The total number of dives on Saipan is therefore estimated to be 215,300, with a minimum and maximum number of 45,800 and 315,800, respectively.

Table 5.4 Estimation of Total Dives per Year for Saipan

Estimate	# Visitors	# Dives	Visitor Dives	Local dives	Total Dives
Minimum	15,000	2	30,000	15,800	45,800
Maximum	75,000	4	300,000	15,800	315,800
Median	66,500	3	199,500	15,800	215,300

Besides diving, a number of other marine-related activities are important determinants of the recreational value of the marine ecosystems of Saipan. Limited resources are available to quantify these activities. The tourist exit surveys gauge optional tour participation rates among the main nationalities of visitors. Scuba diving, underwater observation, and kayaking were some of the tour options available, and participation rates ranged from less than 3% to over 15% (see Table 4.10). Typically, the variation between nationalities is significant. On average, however, we could determine the number of foreign visitors that participate in snorkeling (66,500 people), underwater observation (15,000), scuba diving (66,500), fishing (25,000), parasailing (32,000) and jet skiing (60,000).

Bottom-up approach

The bottom-up approach bases the number of divers and snorklers on visitor numbers on the most popular dive and snorkeling sites on Saipan. The sites include Bird Island, Grotto, Laolao Bay and Managaha Island. The final estimates are shown in Table 5.5.

- *Laolao*: According to the Marianas Visitors Authority (MVA) 52,475 tourists have visited the Laolao Bay by the end of this year. Predictions estimate that 62,970 tourists will have visited the Laolao Bay till the end of this year.
- *Bird Island and the Grotto*: The same study by MVA reveals that from January till October 2005 111,656 tourists have visited the Grotto and it is estimated that by the end of 2005 these figures will rise to 133,987 tourists. Visitor numbers of Bird Island will also be included in this survey, since the Grotto is a part of the Bird Island MPA. The Grotto is primarily visited by divers and spectators, while Bird Island receives

visitors who enjoy the beach and go for walks on trails. The number of visitors arriving on the Bird Island MPA is 199,579.

- *Managaha Island*: Tassi Tours, the company that holds the MPLA concession for Managaha Island and manages the ferry that transports the majority of tourists from Saipan to the island, reported to have transported 182,518 foreign tourists to the island from January till October 2005. When extrapolating these figures for 2005 as a whole, one arrives at a total number of 219,022 visitors. Tassi Tours transported 215,437 foreign tourists in the year 2004. It should also be taken into account that there are also other smaller companies, which transport locals, as well as tourists to Managaha Island. Unfortunately it was not possible to get reliable figures for this group. It is important to note that all the above figures include repeat visitors.

Next, the site-specific information has to be converted to Saipan-wide estimates. By the end of 2005, 529,557 tourists are predicted to have visited Saipan. These foreign visitors and a number of local visitors are predicted to have made 615,558 visits to the three MPAs in the scope of this survey (Laolao, Bird Island including Grotto and Managaha Island). It should be noted that this number includes repeat visitors, meaning that one visitor can be counted several times depending on how many times the tourist visits one or more of the sites during the stay. We assume that 70% of all dives and snorkeling trips take place in the MPAs, as they are the most popular areas on Saipan for these activities. This means that 121,132 dives will have been made in the four MPAs by the end of the year and 129,311 snorkeling trips will be taken. The bottom-up findings are summarized in Table 5.5.

Table 5.5 Frequency of diving and snorkeling activities by site

Site	No. visitors	Diving	Snorkeling
Laolao	62,970	36,908	3,149
Grotto	133,987	80,392	2,680
Managaha	219,022	3,832	109,511
Bird island	199,579	0	13,971
Rest of the island	N/A	66,698	41,305
Total MPAs	*615,558*	*121,132*	*129,311*
Total Island	*529,557*	*215,300*	*137,684*

Monetary valuation of marine related activities

The diving and snorkeling value on Saipan is defined as the sum of the producer and consumer surplus. The marine-related consumer surplus of visitors will be determined in the next section, and is therefore not separately estimated in the diving and snorkeling section. The producer surplus is mainly dependent on the cost price of coral-reef related activities, such as diving and snorkeling. In turn, the cost price of these activities is best reflected by the actual prices paid for in the market. The price range per activity is derived from the data collected through a business survey executed by this study on Saipan. Prices for recreational activities vary between $30 to $70 (see Table 5.6).

Table 5.7 Estimation of revenue of several watersports activities

Watersports	Number of activities	Average price per activity (USD)
Scuba diving	215,300	50
Snorkeling	137,684	30
Jet skiing	60,000	35
Para-sailing	32,000	70
Sea/aqua walker	15,000	65
Fishing	25,000	40

To determine the producer surplus of water sports on Saipan, we applied a similar accounting method to the one used to determine the marine-associated economic value of tourism (see previous section). Although diving is the most important water sport on Saipan, other activities (such as snorkeling, underwater observation and fishing) are also relevant when determining the economic value of Saipan's marine ecosystems. Parasailing and jet skiing are excluded from the economic value because these activities are not truly dependent on healthy marine ecosystems: these activities can take place without the presence of healthy reefs.

Similar to the calculation of the tourist value, we transform the price of each water sport into economic values by applying corrections on the basis of a cost price factor of 0.4 (see Table 5.8). By multiplying the value added with the number of trips for each activity, the total economic value of these recreational activities is determined. The last row of Table 5.8 shows how foreign diving generates most of the economic value of recreational activities. Snorkeling comes in second place. The total (market) value of these marine-related water sports amounts to $5.77 million.

Table 5.8 Direct economic value of marine ecosystem associated water sport activities on Saipan (in $)

Nationality	Diving – Local	Diving – Visitors	Snorkeling	Underwater observation	Fishing
Gross expenses	$30	$50	$30	$65	$40
Cost price factor	40%	40%	40%	40%	40%
Cost price	$12	$20	$12	$26	$16
Number of people	n.a.	66,500	137,684	15,000	25,000
Number of trips per person	n.a.	3	1	1	1
Number of trips	15,800	199,500	137,684	15,000	25,000
Economic (market) value	$189,600	$3,990,000	$798,000	$390,000	$400,000

5.6 Research

CNMI reef ecosystems are in relatively good condition (Turgeon *et al.* 2002). Saipan's proximity to the Indo-Pacific centre of marine biodiversity has led to the presence of more numerous species of stony corals, species of fish, and species of invertebrates. Over time, 6 marine preserves were established: Bird Island Marine Sactuary, Tank Beach Trochus Reserve, Forbidden Island Sanctury, Laolao Bay Sea Cucumber Sanctuary, Lighthouse Trochus Reserve, and Managaha Marine Conservation Area.

The biodiversity of Saipan's coral reefs attracts substantial research funds. As shown in Figure 5.11, three donor organizations (i.e. EPA, DFW, NOAA) dominate the grant provision of funds for monitoring and researching of CNMI's reefs. In the past seven years, more than $5.5 million have been invested in further research, monitoring and education. The annual amount shows a gradual increase over the long term. In this study, we will assume that the market component of the research value of coral reef ecosystems is $788,722 per year.[26] Due to the limited means to estimate the non-market component of biodiversity by means of a survey and the lack of non-market estimates of biodiversity in the literature, this aspect of the total economic value is not taken into account in this study.

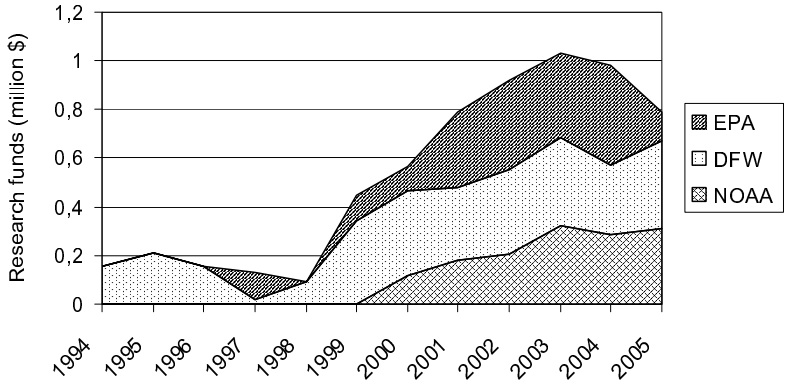

Figure 5.11 Research and monitoring grants in CNMI for the period 1999-2005

5.7 Amenity value

The vicinity of houses and hotels to a healthy marine ecosystem, is generally positively related to the value of the property. In fact, properties close to a coral reef are usually more valuable than comparable properties further from this coral reef. The view of a clean beach and a healthy coral reef is perceived to be a benefit to those who can enjoy it every day. Therefore, beachfront houses along a beautiful coast with clean beaches and healthy coral reefs generally sell for significantly higher prices. Likewise, condos and hotel rooms adjacent to healthy marine systems generally operate at higher room and occupancy rates.

The hedonic pricing method can be used to accurately capture this amenity-associated value on room rates and house prices. Through this method, the surplus value of houses in the vicinity of healthy marine systems can be measured. Combining this with the number of the residential houses leads to a positive amenity value attributable to a healthy coral reef.

Comparable studies have been conducted for beach properties in the US. Wertheim *et al.* (1992) quantify the different relationships between characteristics that affect the value of beach property in the US. Edwards and Gable (1996) estimate the relationship between

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[26] Note that these research funds apply to the CNMI rather than to the reefs of Saipan. Because it was impossible to allocate the funds between Rota, Tinian and Saipan, we thus attribute the full amount to Saipan. As a result of this simplification, this research value should be considered an upper-bound estimate.

beach recreation and property value. Among others, they show that distance to the beach and the quality of the marine ecosystems have a strong impact on the value of properties.

Real estate market on Saipan

To directly determine the extent to which healthy coral reefs affect house prices on Saipan, extensive data on the real estate market are required. Despite numerous efforts to convince real estate agents about the purpose of the study, we failed to retrieve a comprehensive database on house transactions on Saipan. From the limited information we retrieved from real estate agents, we generated the following estimates. The value of land along the beach is around $150 per square meter. Similar land further inland with and without a view on the ocean is valued at around $30 and $10 per square meter, respectively.

The Saipan real estate market is typical, and perhaps distorted, in several ways. First, residential areas along the ocean on the west of the island tend to be occupied by families lower on the socioeconomic ladder. Tanapag, San Roque, San Antonio and Chalan Kanoa are the main residential developments along the lagoon. Otherwise parks, mixed commercial, hotels (i.e. Garapan) and undeveloped property represents the balance. Second, land ownership in the CNMI is limited to CNMI residents. One way or another there is always a local dimension to ownership. Due to this situation the real estate market is characterized as a lease market. Third, a "homestead" program is run on Saipan where locals are afforded favorable terms on certain government land tracts. Fourth, “upscale" residential communities along the beach are lacking. Only the hotels and parks can be considered “upscale” on Saipan.

Valuing amenity effects

Despite the lack of comprehensive data on the real estate market in CNMI and the somewhat typical nature of ownership of real estate on Saipan, we can still determine a coral reef related amenity value by using benefit transfer techniques. Knowing the average price levels and the number of buildings and properties on Saipan, we can apply the value function estimated in other studies to determine the surplus value of coral reef related amenities. The most appropriate value function to be used in this context is the one estimated in Guam (Van Beukering *et al.* 2006).

In Guam, a database containing background information on 828 house sales that took place during the period 2000-2004, was used to derive a value function. The average sales price reported in the dataset is $135,000 per house. The parameters provided in the database include the address, listed price, selling price, surface area, date of sale, and the number of bedrooms and bathrooms. With these data we were able to conduct a regression analysis through which we determined the effect of location on house prices. Obviously, this is not the same as the amenity value of coral reefs, but it does provide an indication of the maximum magnitude of the effect.

The multiple regression analysis (in which several potential determinants of the sales prices of houses in Guam are tested, using a simple OLS), provided the following result (the numbers inside the brackets report the t-values):

Price	US$69,509	- 17*distance	+ 101*surface area	+ 4,053*bathrooms	- 17,818*bedrooms
	(7,652)	(-5.012)	(25.408)	(-6.953)	(2.167)

The explanatory power of the independent variables is substantial (i.e. adjusted R^2 of 0.562). All tested variables proved to be significant. The results broadly show that the further away the property is located from the coast, the lower is the price. In fact, with every additional kilometer away from the coast, the value of the house declines by $17,000. The main question is whether this relationship is dependent on income or the absolute level of the house price. Because we have no knowledge on this particular aspect, we will apply the same value function for Saipan.

The 2000 Census reports a median house value of $159,829 on Saipan. We have no information on how the house prices have evolved on Saipan in the last five years. Therefore, we assume the house prices to have remained constant.

To calculate the amenity value, we subdivided the coastal zone in four parcels: 0-100 meters from coast, 100-250 meters, 250-1000 meters, and everything beyond 1000 meters (see Table 5.9). The only original information available for these four parcels are the 'class 1 building', which are the major structures present in these zones. The background of these data is explained in Chapter 6.

We extrapolate the 'class 1 buildings' to a level covering the total number of buildings on Saipan. The 2000 census reports an average household size of 3.64 persons and mentions a total of 12,507 households in 2000. The census also reports 16,735 concrete houses (i.e. we ignore the 731 houses made of wood pier and pilings). In this study we adopt the latter estimate as the basis of our amenity calculations.

Table 5.9 Estimation of total number of buildings on Saipan

Zone	'Class 1' buildings	Relative share	Up-scaled distribution of properties
Parcel 1: 0-100m from coast	147	5%	837
Parcel 2: 100-250m from coast	332	12%	2,008
Parcel 3: 250m-1000m from coast	188	7%	1,171
Parcel 4: Beyond 1000m	2,136	76%	12,719
Total	2,803	100%	16,735

If we extrapolate the above results (assuming that the amenity effect is neutralized after 1 kilometer) we can calculate the overall amenity value of coastal attributes. Table 5.10 shows how many buildings are located in the various zones. The gross real estate value of the buildings on Saipan amounts to $2.675 billion. The surplus amenity value declines in a linear manner with distance from the coastline. The last column in Table 5.10 shows the aggregated amenity value of $84 million, which is 3% of the gross real estate value. Assuming a discount rate of 5% and a time horizon of 100 years, this suggests an annual value of $4 million.

Table 5.10 Calculation of marine-related amenity value

Zone	Number of buildings (#)	Gross value (*million $*)	Surplus value (*US$/house*)	Gross surplus value (*million $*)
0-100m from coast	837	134	25,500	21
100-250m from coast	2,008	321	22,525	45
250m-1000m from coast	1,171	187	14,875	17
Beyond 1000m	12,719	2,033	0	0
Total		2,675		84

It should be realized, however, that the value of $4 million is an upper bound estimate as it refers to the total value of all marine-related amenities, of which coral reefs are only one element. With the currently available information it is impossible to determine the extent to which the value is specifically dependent on the presence of healthy coral reefs. Coral reefs provide a direct role (i.e. the pleasure of the proximity of a reef) as well as an indirect role (i.e. as a provider of sand grains for white beaches) to the amenity value. Therefore the lower-bound value of the amenity value of coral reefs is by definition more than zero. We arbitrarily assume that the lower bound value of coral reefs is 25% of the total amenity value. This implies an average coral reef related amenity value of $3 million, with a lower- and upper-bound estimate of $1 million and $4 million, respectively.

5.8 Coastal protection

The role of reefs in coastal protection

Coastal erosion, inundation, and flood risk depend on physical properties of a given island (i.e. elevation, rock and soil-type, and location) as well as on biological properties (i.e. existence of buffering habitats, such as coral reefs and mangroves). Because reefs absorb much of the incoming wave energy they function as natural breakwaters and help to protect the shoreline from erosion. For example, measurements showed that up to 77% of the force of waves in Nicaragua is eliminated by discontinuous coral reefs (UN Atlas of the Ocean, 2000). In other words, without the wave buffering and sand production roles of coral reefs, rates of coastal erosion and beach loss (and associated economic damage) would be significantly higher (SEAGRANT, 2002).

Previous studies in the Northern Mariana Islands provide quantitative analyses of how the coastal profile influences the dissipation of wave energy (Doan and Siegrist 1979; Richmond 1994). To demonstrate the impact of the coastal profile on the tempering waves, Figure 5.12 shows schematic coastline profiles of Saipan and Hawaii. In areas where broad reef flats are part of the coast, wave energy is spread over a larger area; in locations where steep, rocky coastlines prevail, wave energy tends to be concentrated on a smaller area. In many places where storm damage required rebuilding of infrastructure, such as after Hurricane Iwa in 1981, an examination of geologic and storm-susceptibility maps would have suggested that a reasonable construction ‘setback’ would have reduced insured losses (Richmond, 1994).

Simply replacing the buffer function of coral reefs by manmade structures generally works counterproductive, as these structures themselves may have negative effects.

Often, the introduction of manmade structures leads to increased rates of beach erosion. For example, preliminary examination of a report on shoreline changes from 1949 to 1989 in Hawaii suggests that i) 62% of the sandy shoreline studied on Maui is eroding at an average rate of 1.25 ft/yr (Hwang and Fletcher, 1992), and ii) as much as 30% of Maui's shoreline has experienced beach loss or significant narrowing (Makai Ocean Engineering, Inc. and Sea Engineering, Inc., 1991). Based on field and photographic observations, nearly all of this beach degradation is in front of or adjacent to shoreline armoring such as seawalls and revetments.

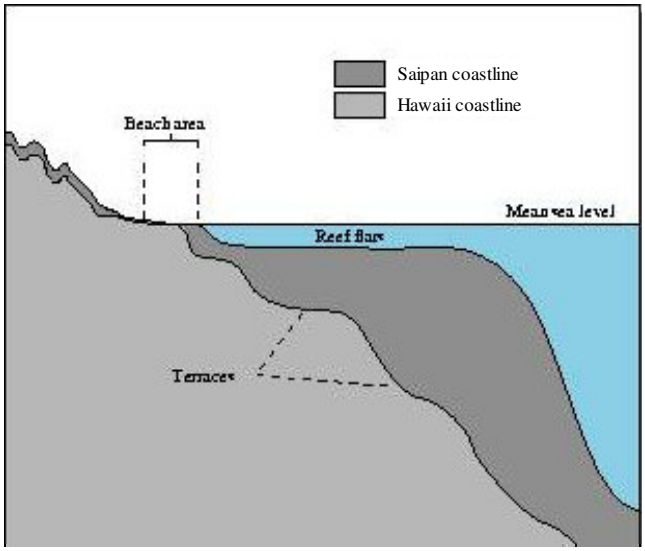


Figure 5.12Coastline profile of Saipan and Hawaii

Storms and typhoons on Saipan

Because of its location in the “typhoon belt” and constant threat of tropical cyclones, the coastal protection function of coral reefs on Saipan is very important. During the period 1945-1994, there were 183 tropical storms and typhoons, which passed within 180 nmi (nautical mile) of Saipan. As shown in Figure 5.13, most tropical storms on Saipan come from the east (around 80%). The remaining 20% of storms come from the west (Richmond and Davis, 2002).

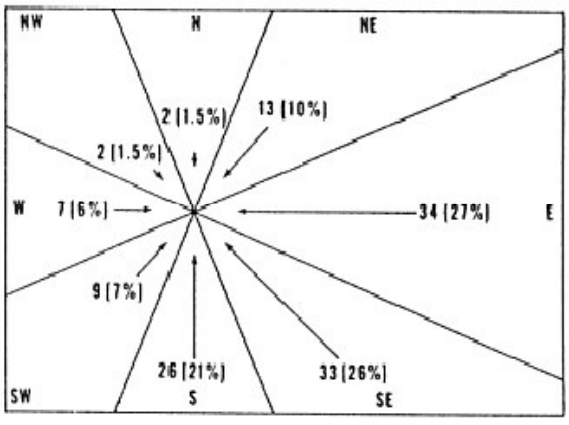


Figure 5.13 Storm directions on Saipan (circles contain number of storms in the period 1945-1994) (source: Richmond and Davis, 2002)

The height of waves and storm surges created by tropical storms with and without protection provided by coral reefs on Saipan are shown in Figure 5.14. The maps show wave heights in meters during storms in a situation with reefs (i.e. wave height varies between 1 and 6 meters) and without reefs (i.e. wave height varies between 3 and 10 meters). In a situation 'with coral reefs' (see (a) and (b)), waves are expected to be two times lower than in a situation 'without coral reefs' (see (c) and (d)) (UN Atlas of the Ocean, 2000).

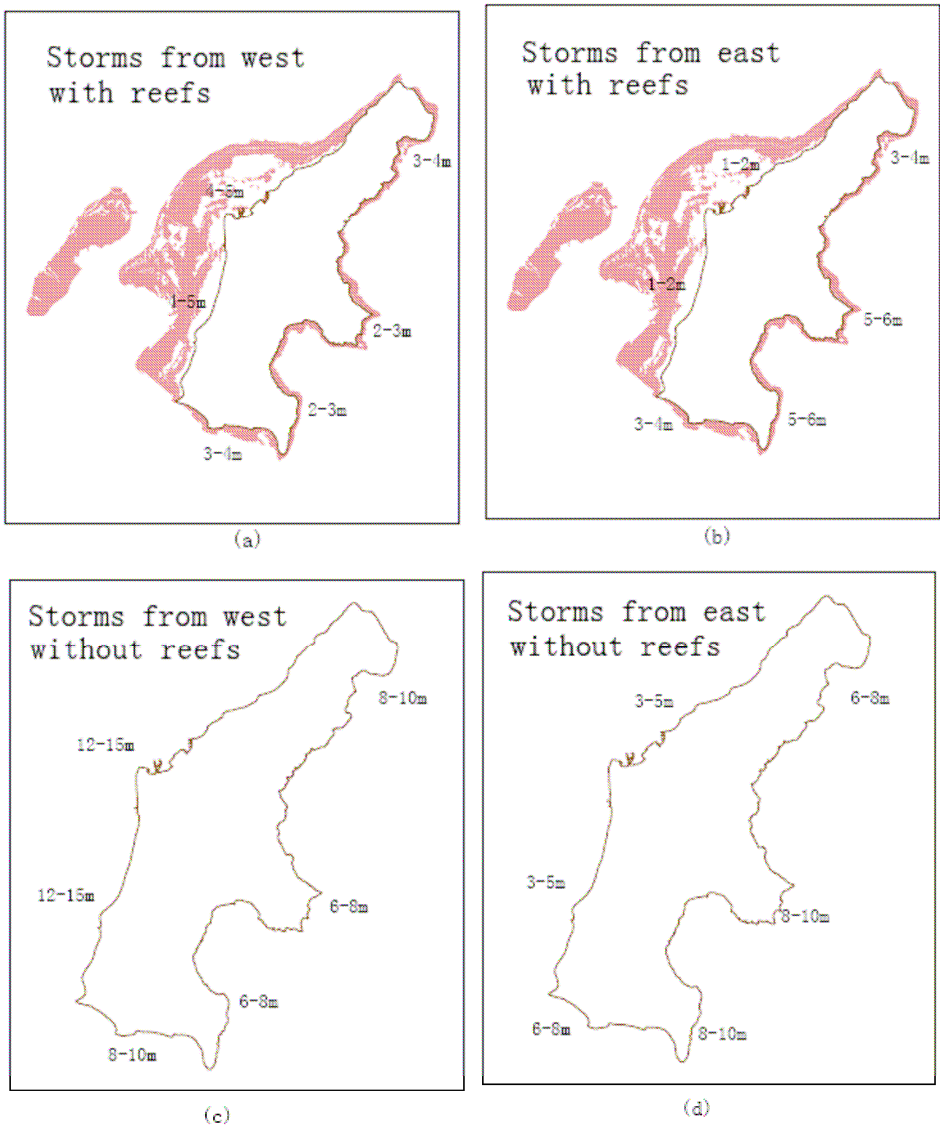


Figure 5.14 Potential height of waves and storm surges with and without coral reefs

The hidden value of coastal protection

The actual value of coral reefs in terms of protecting the coastal zone is not visible unless the reefs degrade and the storm surges become more destructive, causing more damage than before. Therefore, we can only calculate this 'hidden' economic value of coastal protection (i.e. avoided damage) by comparing hypothetical situations in which the intensity of storms (assessed by means of wave height) and the presence of healthy coral reefs varies.

The amount of damage depends on the density of buildings and infrastructure. The higher the density of potentially vulnerable buildings, the greater the coastal protection value of coral reefs. Through GIS, the potential flooding zones created by storms coming from both the west and the east, have been identified for a situation with and without reefs. Next, the number of buildings in these flooding zones was counted and valued accordingly (see Table 5.11). Valuation was done on the basis of the average value of buildings on Saipan, estimated in the previous Section (i.e. $159,829).

In limiting typhoon damage to the buffering function of coral reefs, we need to take into account several specific effects. First, typhoons not only cause damage through flooding, but also inflict substantial damage through wind, rain and landslides. Second, affected houses are not always completely damaged but may need significant repair after floods hit the property. Therefore, when calculating the coastal protection value of coral reefs on Saipan, we need to make assumptions about the average damage done by storms. We calculated that the average value of a piece of property is $159,829; we go on to assume that an affected house will be damaged in the magnitude of 5% of the property. Combining this information with our knowledge of storm direction (a division of 80/20 coming from east and west), we can determine the avoided damage attributable to healthy coral reefs. With healthy reefs, the average damage each year amounts to $3.55 million. Without the presence of coral reefs, this damage would increase to a level of $11.59 million per year. Therefore, the coastal protection value of coral reefs on Saipan is determined to be $8.04 million per annum (i.e. $7.8 million at the West coast and $0.2 at the East coast).

Table 5.11 Number of buildings at risk in one year for Western and Eastern storms in a situation with and without coral reefs (in $)

Scenario	West	East
Potentially destroyed buildings 'with reefs' *(# building)*	396	48
Additional potentially destroyed buildings 'without reefs' *(# building)*	1375	75
Value of at risk buildings 'with reefs' *(million $)*	63	8
Additional potentially destroyed buildings 'without reefs' *(million $)*	220	12
Ratio of property value loss of affected building	5%	5%
Value of at risk buildings 'with reefs' *(million $)*	3.2	0.4
Additional potentially destroyed buildings 'without reefs' *(million $)*	7.8	0.2

5.9 Total economic value

The next step in the analysis is the calculation of the TEV by aggregating the economic values of the individual coral reef associated goods and services (see Table 5.12). The aggregated TEV of $61.16 million represents the economic importance, in absolute terms, of market and non-market values of coral reefs on Saipan. The importance for the tourist industry account for 69% of the TEV. Of second and third importance are coastal protection (i.e. 13%) and the recreational activities (i.e. 9%), respectively. Typically, the market value of fisheries is almost negligible compared to the other non-consumptive goods and services. This forms a strong argument to promote more sustainable fishery policies, since a further decline of the fish stock will also negatively affect more valuable goods such as tourism, diving and snorkeling. All in all, coral reefs and its surrounding

marine environment represent a significant asset to Saipan's economy and culture. This importance is not entirely reflected by the funds that are made available by the Saipan government to manage the reefs.

Table 5.12 Total Economic Value of coral reefs on Saipan

Type of reef-related value	Market value (*million $/year*)	Non-market value (*million $/year*)	Economic value (*million $/year*)
Tourism	37.7	4.61	*42.31*
Diving and snorkeling	5.77	n.a.	5.77
Fishery	0.43	0.83	1.25
Amenity	n.a.	3	3
Coastal protection	n.a.	8.04	8.04
Biodiversity	0.79	n.a.	0.79
Total Economic Value	44.69	16.48	61.16

We recognize the fact that there are a number of conceptual and empirical problems inherent in producing the estimates of the TEV of the coral reefs of Saipan. For example, various techniques have been used simultaneously in the process of economic valuation to determine the TEV. Although we carefully tried to prevent overlapping values, such an approach is still somewhat uncommon in valuation studies. Studies that have attempted similar exercises have been criticized in the scientific community for their disregard for the significant uncertainties in the data and the underlying assumptions (see, for example, Constanza *et al.* 1997). We stress, however, that given the limited availability of secondary data on socio-economic and ecological issues, uncertainties in the analysis can never be eliminated. Therefore, given the available data and the time and effort spent on primary and secondary data collection, more precise estimates of the TEV of the coral reefs of Saipan will be difficult. Therefore, we consider the relatively crude initial estimate of the TEV for coral reefs on Saipan as a useful starting point for further research.

To demonstrate the level of uncertainty of the initial estimate Table 5.13 provides an overview of the minimum and maximum estimates that have been determined for various individual value categories. The range for tourism benefits from $29 to $54 million is determined by the extent to which the income of the tourist industry can be attributed to marine-related goods and services. The range for diving and snorkeling between $3.6 and $7.1 million is based on different levels of participants in watersports activities. The range in fishery benefits from $0.5 to $2.0 million is mainly based on scenario assumptions in the choice experiment. The range in the amenity values is determined by the extent to which the amenity surplus is attributable to coral reefs as opposed to marine-related amenities in general. The limited amount of data underlying the calculations for coastal protection and research values did not allow for variations in these two value categories. Ultimately, the total economic value of coral reefs on Saipan varies between $42 million and $76 million, with a core estimate of $61 million per year.

Table 5.14 Estimate ranges of the total economic value (million $/year)

	Tourism	Diving & snorkeling	Fishery	Amenity	Costal protection	Biodiversity	Total
Minimum	28.53	3.56	0.51	1.00	8.04	0.79	42.43
Maximum	53.83	7.13	2.00	4.00	8.04	0.79	75.79
Core estimate	42.31	5.77	1.25	3.00	8.04	0.79	61.16

6. GIS and economic valuation

6.1 Introduction

The interaction between the economy and the environment form both the focus of and main barrier to applied research within the field of environmental economics. These interactions exist in various ways. For example, the nexus between economy and environment varies over time and space. Regarding the latter dimension, geographical information systems (GIS) allow environmental economists to tackle such complexity head on by directly incorporating diverse data sets into applied research rather than resorting to simplifying and making (often unrealistic) assumptions (Bateman *et al.* 2003). GIS is particularly useful in bringing together spatially relevant economic and environmental data. This principle also holds true for the analysis of the economic value of coral reefs on Saipan.

The spatial dimension of interactions between the economy and coral reef ecosystems are relevant at various levels, including:

- *Threats* (e.g. the distance from stormwater runoff channel to the reef, locations most prone to typhoon damage, areas of coastal development, sites with high fishing pressure, jet-ski areas);
- *Benefits* (such as the travel time/distance of potential visitors, spill-over distance of juvenile fish moving between MPAs and fishing grounds, distribution of real estate along the coastline, etc.); and
- *Distributional aspects* (e.g. where the winners and losers of specific management interventions are situated).

The use of GIS in economic analysis of coral reefs is rare. One of the few applications of GIS in this context is provided by Bryant *et al.* (1998). Given the significant spatial variation in reef values within a region, and the capability of GIS to make this spatial variation explicit, the sporadic use of this type of tool is remarkable. For example, a recent study in American Samoa showed that reef values in some areas were up to 130 times the territory average (Spurgeon and Roxburgh, 2004). Major over- or underestimation can occur if values are extended (without adjustments) to another area of reef or are extrapolated across whole regions. Therefore, more research is needed on factors affecting the spatial distribution of values and the magnitude of variation between benefits (e.g. through meta analyses at the regional level), as well as an examination of the potential for map-based tools (Roxburgh *et al., 2005*).

In this study, we applied GIS techniques to spatial economic valuation of coral reefs on Saipan. We looked in detail at issues such as recreational revenues and real estate values. Overlays were created of coral reefs, population, tourist-use, and real-estate markets to analyze the relationships between these variables. Such analysis helps us to improve our understanding of the spatial variation in the economic value of coral reefs. The main goal of applying GIS was to demonstrate that coral reefs have different economic values at different locations. Combining this knowledge with the fact that different anthropogenic threats occur at different locations, we can identify specific areas of coral reefs that require urgent management actions.

Various data sources were used in this endeavor. Firstly, the recent NOAA GIS data on coral reefs on Saipan was used (see Figure 6.1). Further data was available from the ReefBase Online GIS, which enabled us to display coral reef related data and information on interactive maps. Also, maps were used from ESRI, which has various datasets based on the United States Geological Survey. Moreover, many GIS overlays of Saipan were retrieved from various local and federal government agencies.

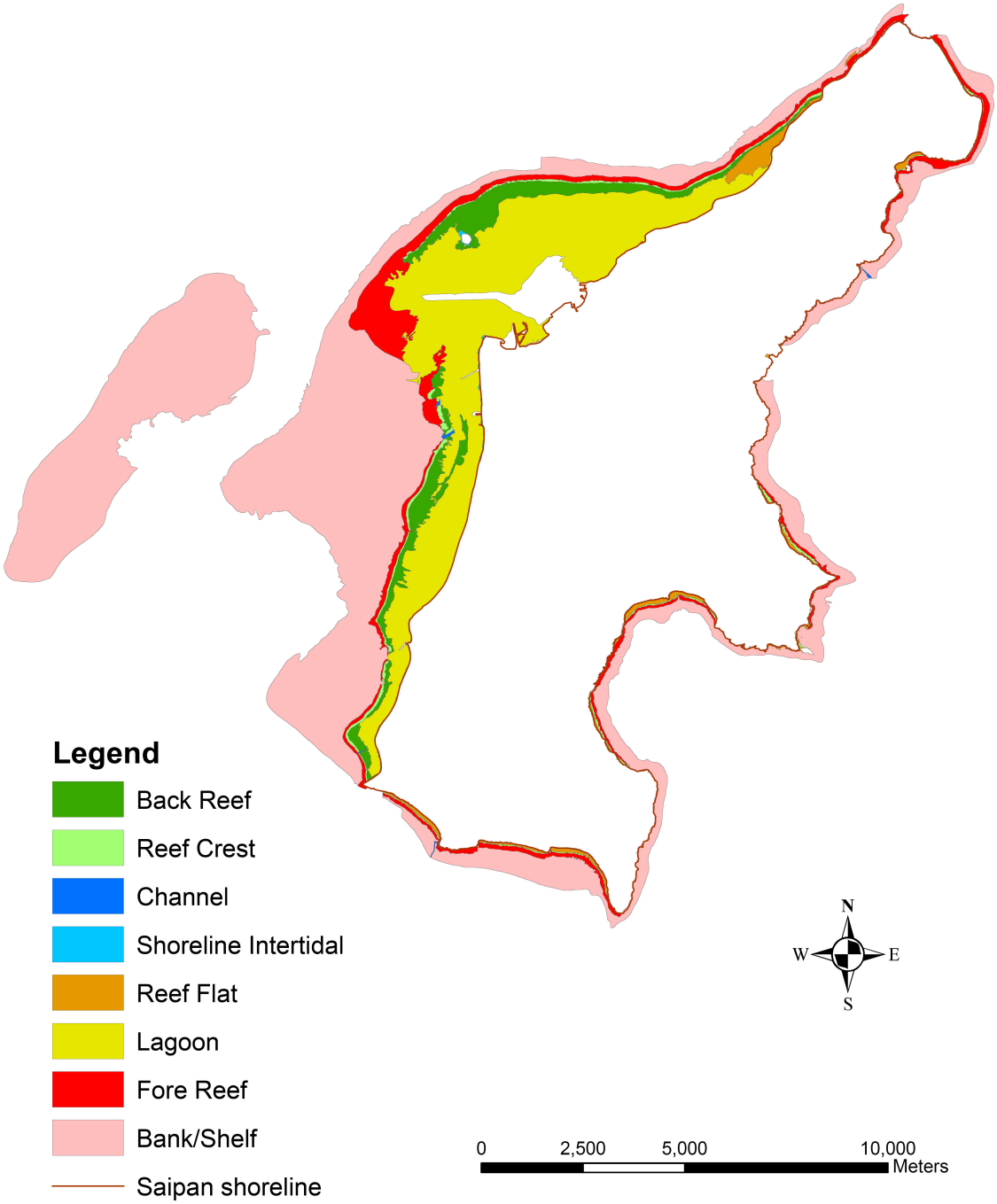


Figure 6.1 Coral reefs on Saipan

Source: NOAA 2005

Economic values associated with coral reefs on Saipan were allocated spatially across the reefs with the help of GIS tools; subsequently all the maps were overlapped to get the final thematic map of the economic value distribution. After comparing this with a map of anthropogenic threats, the priority coral reefs are revealed.

The general methodology followed three distinct steps. Firstly, we allocated economic values, which were calculated in the previous chapters (see Table 6.1), to coral reefs in terms of tourism, coastal protection, amenity and biodiversity. Secondly, we overlaid these individual value maps to produce the thematic map in which the distribution of the total economic value of coral reefs can be seen. This allowed for the ranking of coral reefs based on their allocated economic value. Thirdly, we compared the distribution of total economic value with the literature on anthropogenic threats to coral reefs in order to determine which coral reefs should receive priority protection. In other words, the aim was to work out which coral reefs had a high economic value *and* faced serious threats. The method is explained in more detail in the coming sections. All benefit categories have been spatially allocated, except for fisheries benefits, for which too little scientific data were available to distribute these values in a reasonable manner. To demonstrate spatial variability of the economic value of reefs in Saipan, many assumptions had to be made which could not always be verified by existing data or literature, but instead was based on expert judgments. The purpose of this Chapter is therefore illustrative rather than a prescriptive.

Table 6.1 Coral reef related valuation on Saipan

Type of reef-related value	Economic value (million $/year)
Tourism	42.31
Diving and snorkeling	5.77
Amenity	3.00
Coastal protection	7.83 (Tropical storm from west) 0.20 (Tropical storm from east)
Research	0.79

6.2 Tourism

The recreational and tourism sites on Saipan influencing the coral reef economic values include diving and snorkeling spots, beaches, parks and hotels. This section focuses solely on beaches, parks and hotels. In line with the economic valuation procedure, diving and snorkeling spots are discussed in the next section. As for general tourism, coral reef categorization is mainly based on beaches, parks and hotels, with the premise that coral reefs closer to recreational sites are more valuable for tourism.

Physical quantification

The role of coral reefs in the tourism industry is not constant in space. To capture this spatial variability, two principles are followed. First, coral reefs closer to tourist locations are responsible for generating more income from tourism. As shown in Figure 6.2(a), “dotted” coral reefs (inner circle) are more valuable than “striped” coral reefs (first ring) because of its proximity to the tourist site. Likewise, “striped” coral reefs (first ring) are more valuable than “checked” coral reefs (second ring). Second, coral reefs related to more tourism sites are more important. Figure 6.2(b) simulates a situation

in which there are two tourist sites close to each other. Coral reefs in blue are within 500m from both tourist sites, implying they are linked to two tourist sites. In contrast, the coral reefs in "grey" are linked to only one tourist site. Thus, "dotted" coral reefs are more valuable than those in grey.

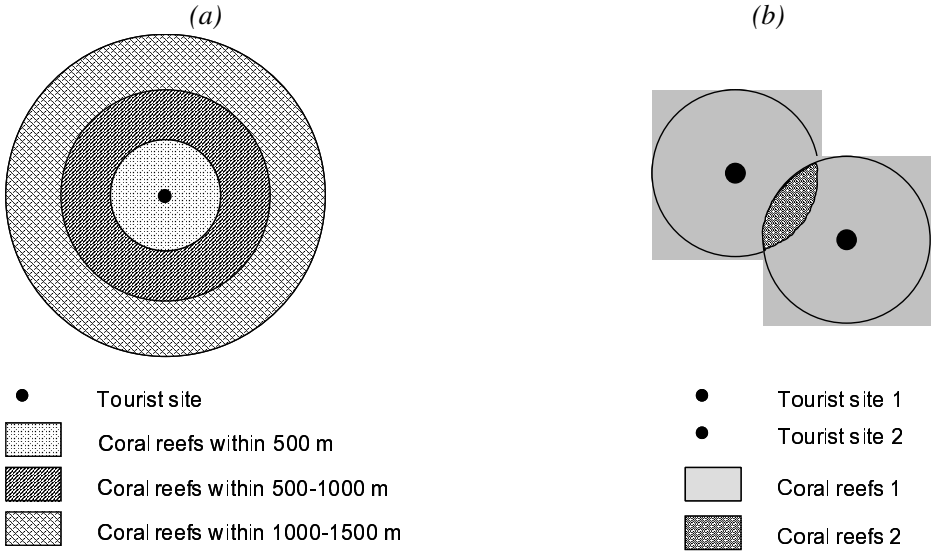


Figure 6.2 Two principles used in the distribution of tourism value of coral reefs

Following these two principles, several steps are taken to arrive at the economic value of coral reefs in relation to tourism on Saipan. First, coral reefs were classified into four categories (i.e. High, Medium, Low and Zero tourism value) according to their distance from these recreational sites. Coral reefs within 500 meters of recreational sites are considered to have a high tourism value, between 500 meters and 1000 meters a medium tourism value, and between 1000 meters and 1500 meters a low tourism value. Reefs beyond 1500 meters of recreational sites are considered to have no tourism value.

Next, we further divided coral reefs with high, medium and low tourism values into more detailed sub-categories using GIS software. In these sub-categories, coral reefs associated with all three types of recreational site (i.e. park, hotel, beach) have a high value. Those associated with either two of these three types of recreational site have a medium value, while those associated with one type of recreational site are seen as low value reefs.

- *Coral reefs 0-500m (3 types)*: Coral reefs within 500m of recreational sites and associated with all three types of recreational site
- *Coral reefs 0-500m (2 types):* Coral reefs within 500m of recreational sites and associated with either two out of three types of recreational site
- *Coral reefs 0-500m (1 type):* Coral reefs within 500m of recreational sites and associated with one out of three types of recreational site
- *Coral reefs 500-1000m (3 types):* Coral reefs within 500-1000m of recreational sites and associated with all three types of recreational site
- *Coral reefs 500-1000m (2 types):* Coral reefs within 500-1000m of recreational sites and associated with either two out of three types of recreational site
- *Coral reefs 500-1000m (1 type):* Coral reefs within 500-1000m of recreational sites and associated with one out of three types of recreational site

- *Coral reefs 1000-1500m (3 types):* Coral reefs within 1000-1500m of recreational sites and associated with all three types of recreational site
- *Coral reefs 1000-1500m (2 types):* Coral reefs within 1000-1500m of recreational sites and associated with either two out of three types of recreational site
- *Coral reefs 1000-1500m (1 type):* Coral reefs within 1000-1500m of recreational sites and associated with one out of three types of recreational site
- *Coral reefs beyond 1500m:* Coral reefs beyond 1500m of any recreational site

These various categories are presented in Figure 6.3. It is clear where the reefs, which enjoy the highest tourism interest, are located.

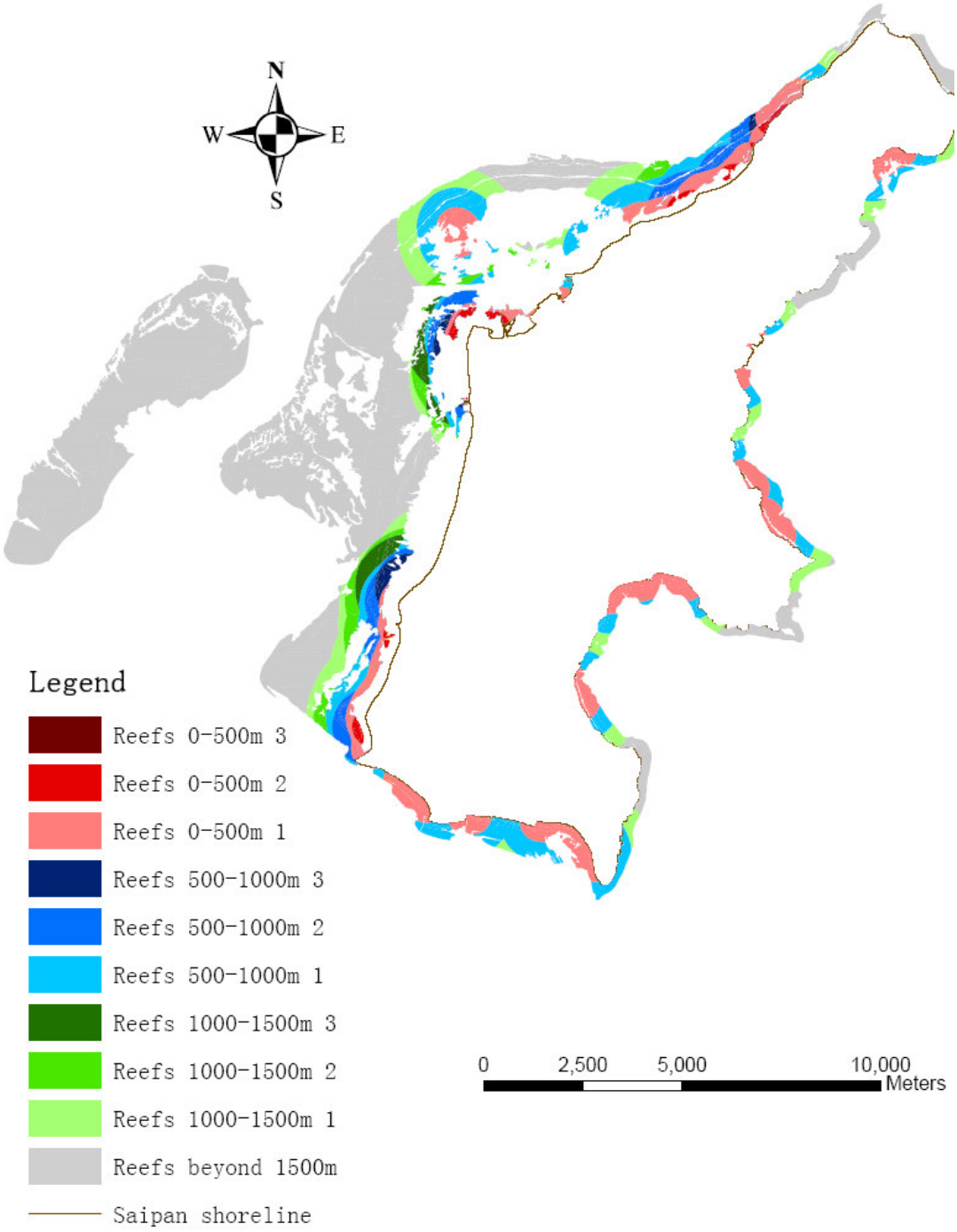


Figure 6.3 Coral-reef based tourism on Saipan

Final categories and weights can be seen in Table 6.2 below. The area of each category also needed to be taken into account. The method is similar to the one used in the fishery component, with the spatial distribution of tourism values being based on a weighted score. Weights of $9/13^{th}$, $3/13^{th}$ and $1/13^{th}$ were applied for the proximity zones 0-500 meters, 500-1000 meters and 1000-1500 meters, respectively. Sites with three, two and one functions received 45%, 30% and 25%, respectively. The overall weights resulting from this exercise are shown in the last column of Table 6.2.

A disadvantage of the above-mentioned methodology is that it treats coral reefs as somewhat isolated systems. In reality, the coral reefs of Saipan are mutually connected by exchanging fish and larvae. In other words, attaching value to points rather than larger systems has its drawbacks from an ecological point of view. If the full ecological complexity would be accounted for, the "upstream" reefs would also need to be credited for their ecological role in maintaining healthy reefs for tourists, divers and properties. However, because the necessary maps and data for Saipan as a whole are lacking to incorporate such ecological dimension to the GIS analysis, we limited the spatial analysis to the above-mentioned approach.

Table 6.2 Weights and scores of the various categories of tourist-related reefs

Category	Weight	Sub-category	Weight	Overall weight
High (reefs within 0-500m of recreational sites)	9	High	45%	4.05
		Medium	30%	2.70
		Low	25%	2.25
Medium (reefs within 500-1000m of recreational sites)	3	High	45%	1.35
		Medium	30%	0.90
		Low	25%	0.75
Low (reefs within 1000-1500m of recreational sites)	1	High	45%	0.45
		Medium	30%	0.30
		Low	25%	0.25
Zero (reefs beyond 1500m of recreational sites)	0	None	0%	0.00

We have an ecologically-based concern with the value and weights that are put on tourist dive sites. This report equates distance from the dive site with decreasing value of the reef by using a weighting structure that heavily favors the 500 m circle around each dive site. This infers that coral reefs are isolated systems.

Monetary valuation

On the basis of the above information, the total value of coral-reef related tourism of $42.31 million per year can be allocated spatially. Table 6.3, shows the method followed to generate an economic value per unit area. Firstly, a final score for each (sub)category was determined by multiplying the overall weight from Table 6.2 by the actual area of each (sub)category. Secondly, this final score was used as the key to allocate the coral reef tourist value across the (sub)categories. Finally, this value was divided by the area of each (sub)category to arrive at a tourist value per unit area.

Table 6.3 Coral reef tourism model used on Saipan

Category	Sub-category	Overall weight*	Area (km^2)	Score	Tourism value (US$)	Value per unit area ($US\$.km^{-2}.year^{-1}$)
High (reefs 0-500m from sites)	High 3	4.05	0.46	1.86	2,506,795	5,449,554
	Medium 2	2.70	0.61	1.65	2,216,152	3,633,036
	Low 1	2.25	6.66	14.99	20,163,351	3,027,530
Medium (reefs 500-1000m from sites)	High 3	1.35	2.09	2.82	3,796,523	1,816,518
	Medium 2	0.90	2.97	2.67	3,596,706	1,211,012
	Low 1	0.75	5.90	4.43	5,957,437	1,009,177
Low (reefs 1000-1500m sites)	High 3	0.50	1.42	0.64	859,819	605,506
	Medium 2	0.30	3.46	1.04	1,396,701	403,671
	Low 1	0.25	5.40	1.35	1,816,518	336,392
Total	--	1.00	28.90	--	42,310,000	--

After re-categorizing coral reefs according to the corresponding value per unit area, a map was created which reflected the spatial variation of the tourism value (see Figure 6.4).

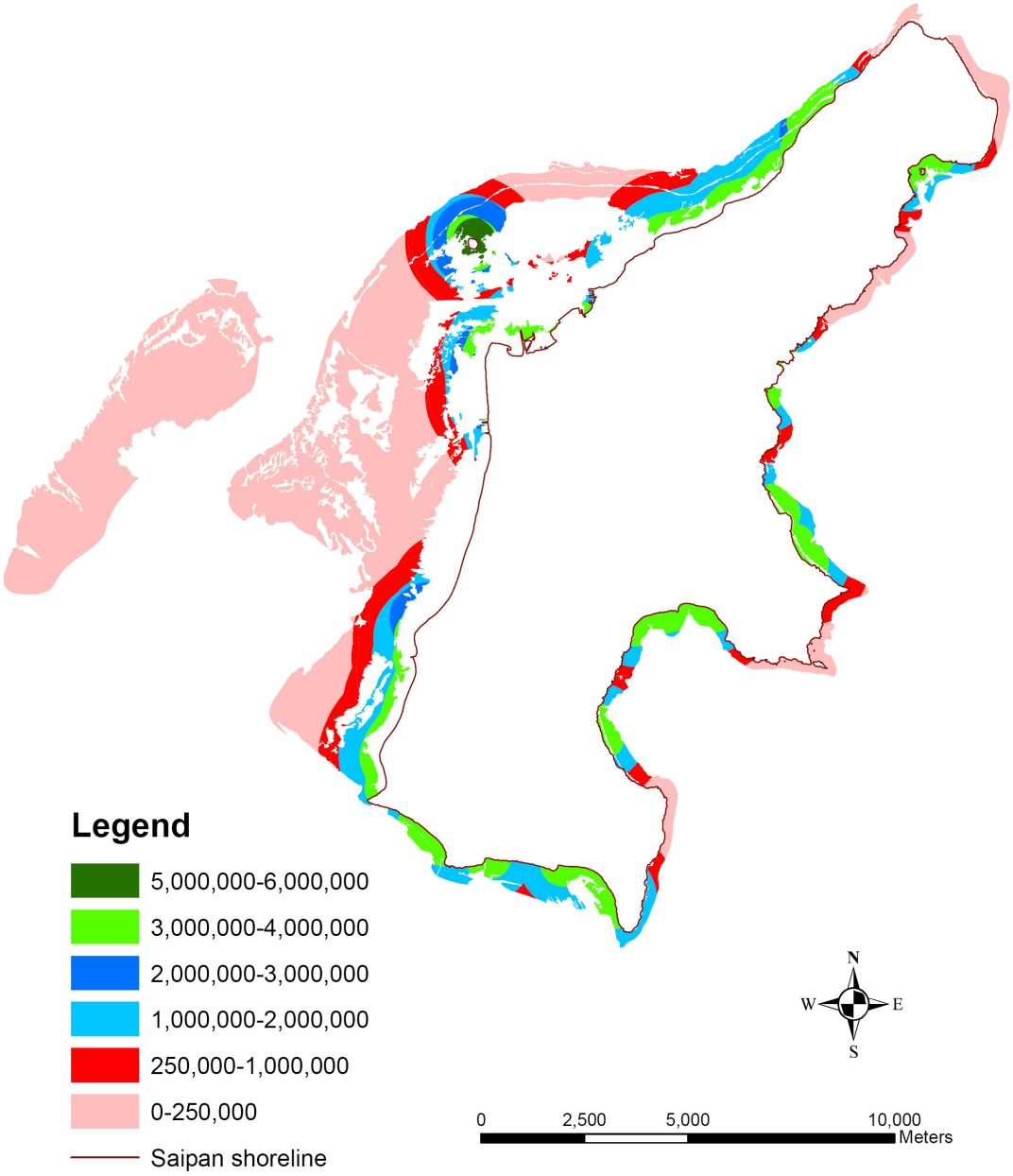


Figure 6.4 Coral reef tourism value distribution on Saipan (in $/km^2/year)

6.3 Diving and snorkeling

Diving and snorkeling are discussed separately from other tourism values because these activities are more directly related to coral reefs. Every year many tourists, who are different from other general tourists, visit Saipan just for diving and snorkeling.

Physical quantification

To make the diving and snorkeling value spatially explicit, an alternative method was required. Firstly, diving and snorkeling spots were divided into three categories according to their popularity (i.e. most popular, popular and not popular spots). We considered each "popularity" category as one layer and then focused on each layer, in

turn. The three levels in this category were determined on the basis of information retrieved from various sources (see Figure 6.5). The GIS layer is based on:

- A map downloaded from the CRM website which presents 18 dive and snorkel sites on Saipan, but does not provide the accurate locations (http://www.crm.gov.mp/coral.pdf);
- GIS data (e.g. vector type) also published by CRM which shows the locations of 13 dive and snorkel sites on Saipan.
- Local experts (i.e. divers and dive operators) produced a map of an additional 5 dive and snorkel sites, and determined the level of popularity of each site.

Secondly, reefs within each layer were sub-categorized based on their distance from diving and snorkeling spots. Coral reefs closer to diving and snorkeling sites are considered to have higher values in terms of diving and snorkeling. Following this principle, coral reefs were categorized in terms of distance to the dive and snorkeling spots. Coral reefs within 100 meters of diving sites were considered to have the highest value, within 100-200 meters a medium value, within 200-300 meters a low value, and beyond 300 meters no dive value at all (being too far from diving sites).

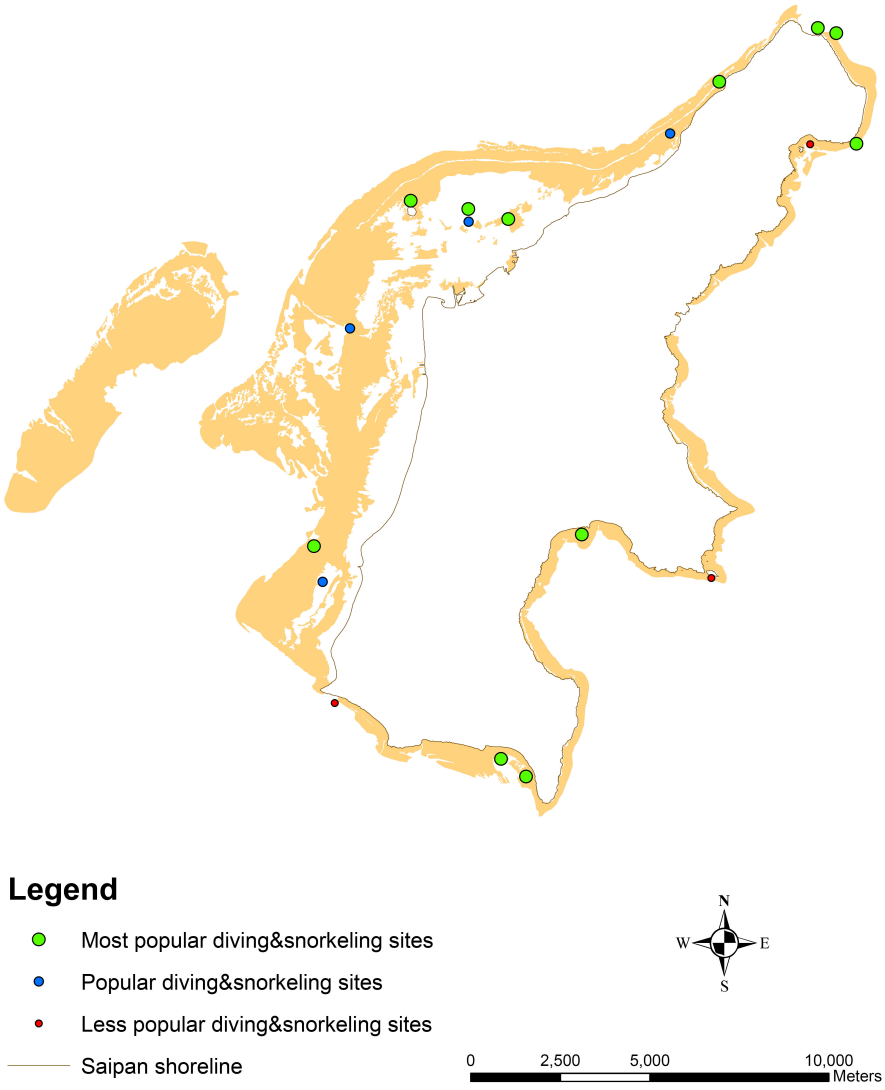


Figure 6.5 Diving and snorkeling sites on Saipan

Monetary valuation

The next step was to spatially allocate the diving and snorkeling values. The total value was apportioned to each category based on the proportion of the score to the sum of all three scores. The reef-related diving and snorkeling value on Saipan is $5.77 million per year. As mentioned, the dive value of coral reefs is divided into three categories (i.e. most popular, popular and not popular). Their importance is different in terms of diving and snorkeling values. The most popular diving sites attract most of the divers; therefore, most of the diving and snorkeling revenues were attributed to the most popular sites.

When assigning the weights, 10 out of 14 was given to the most popular sites. Popular sites are also more important than not popular sites. 3 out of 14 was assigned to popular diving sites. Not popular sites only received 1 out of 14 (See Table 6.4).

Table 6.4 Categories and weights used in the diving and snorkeling model on Saipan

Category	Weight	Reef area (km^2)	Score (Weight*Reef area)	Allocated value (million $)
Most Popular	10	1.61	16.11	5.07
Popular	3	0.62	1.85	0.58
Less Popular	1	0.36	0.37	0.12
Total		2.59		5.77

As can be seen in Table 6.5, each category was divided into three sub-categories and weights were given to these three sub-categories. Most divers enjoyed the beautiful views underwater, which were within 100 m from diving sites. Some of the divers could travel 100-200m from the diving sites where they started. Few divers could travel 200-300m from the diving sites. Based on these facts, 60%, 30% and 10% were assigned to these three sub-categories, respectively.

Table 6.5 Sub-categories and weights used in the diving and snorkeling module on Saipan

Category	Sub-category	Weight	Reef area (km^2)	Score (Weight* Reef area)	Allocated value ($)	Diving value per unit area ($/$km^2$/year)
Most	H.(100-200m)	60%	0.22	0.13	1,734,474	7,847,161
Popular	M.(100-200m)	30%	0.58	0.17	2,268,158	3,898,116
	L.(200-300m)	10%	0.81	0.08	1,067,368	1,320,968
Popular	H.(100-200m)	60%	0.07	0.04	178,462	2,611,530
	M.(100-200m)	30%	0.18	0.05	223,077	1,274,638
	L.(200-300m)	10%	0.37	0.04	178,462	480,081
Less	H.(100-200m)	60%	0.05	0.03	45,000	826,052
Popular	M.(100-200m)	30%	0.11	0.03	45,000	401,255
	L.(200-300m)	10%	0.20	0.02	30,000	148,485
Total			2.59		5,770,000	

After overlaying the three categories and adding up the corresponding value per unit area, we produced the map shown in Figure 6.6.

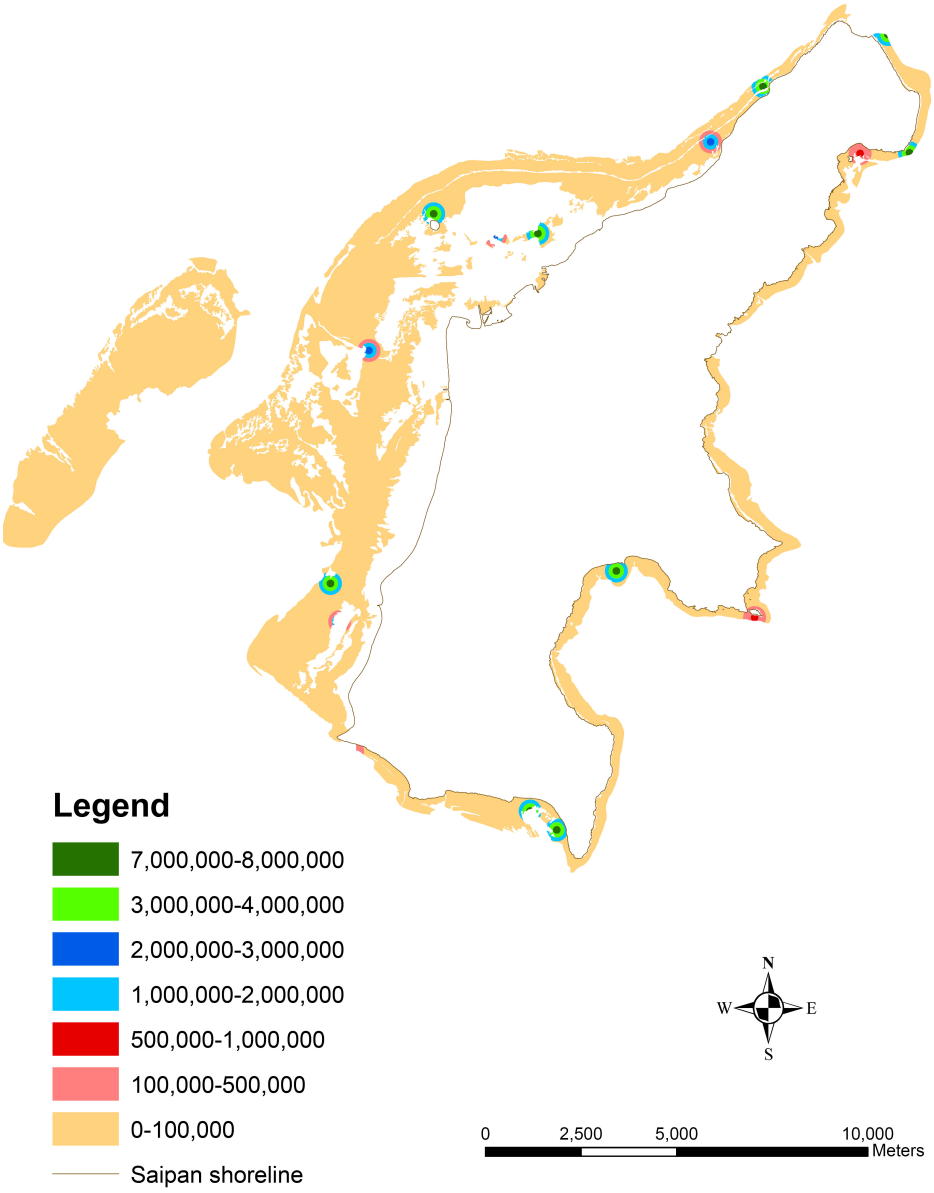


Figure 6.6 Distribution of reef-related diving and snorkeling value on Saipan (in $/km^2/year)

6.4 Amenity value

Coral reefs can provide amenities to people living within a certain distance of the coast, and the closer to the coast, the more amenity value can be enjoyed. The method based on this assumption includes the following steps. First, we divided the island into 4 parcels:

- Parcels on the coastline (0-100 meters inland)
- Parcels 100-250 meters inland
- Parcels 250-1000 meters inland
- Parcels beyond 1000 meters from the coastline

For technical reasons and reasons of simplification, we assumed (in the GIS analysis) that 'Parcel 4' is too far from the coastline to enjoy the amenity value of coral reefs. Therefore, we allocated the small amenity value of Parcel 4 (see previous Chapter) across the other parcels and limited our analysis to Parcels 1, 2 and 3, respectively.

Physical quantification

In the previous Chapter, the amenity value relating to Parcel 1, Parcel 2, Parcel 3 and Parcel 4 was calculated. We take Parcel 1 as an example to explain the method used to allocate these values. GIS software was used to identify coral reefs within 1000 meters of Parcel 1. Coral reefs identified here are categorized as coral reef layer 1. Parcels 2 and 3 were then used to produce coral reef layer 2 and layer 3. Each coral reef layer was divided into two parts, 0-500 meters from parcels and 500-1000 meters from parcels, because coral reefs closer to the coast have higher amenity values. The details can be seen in Figure 6.7.

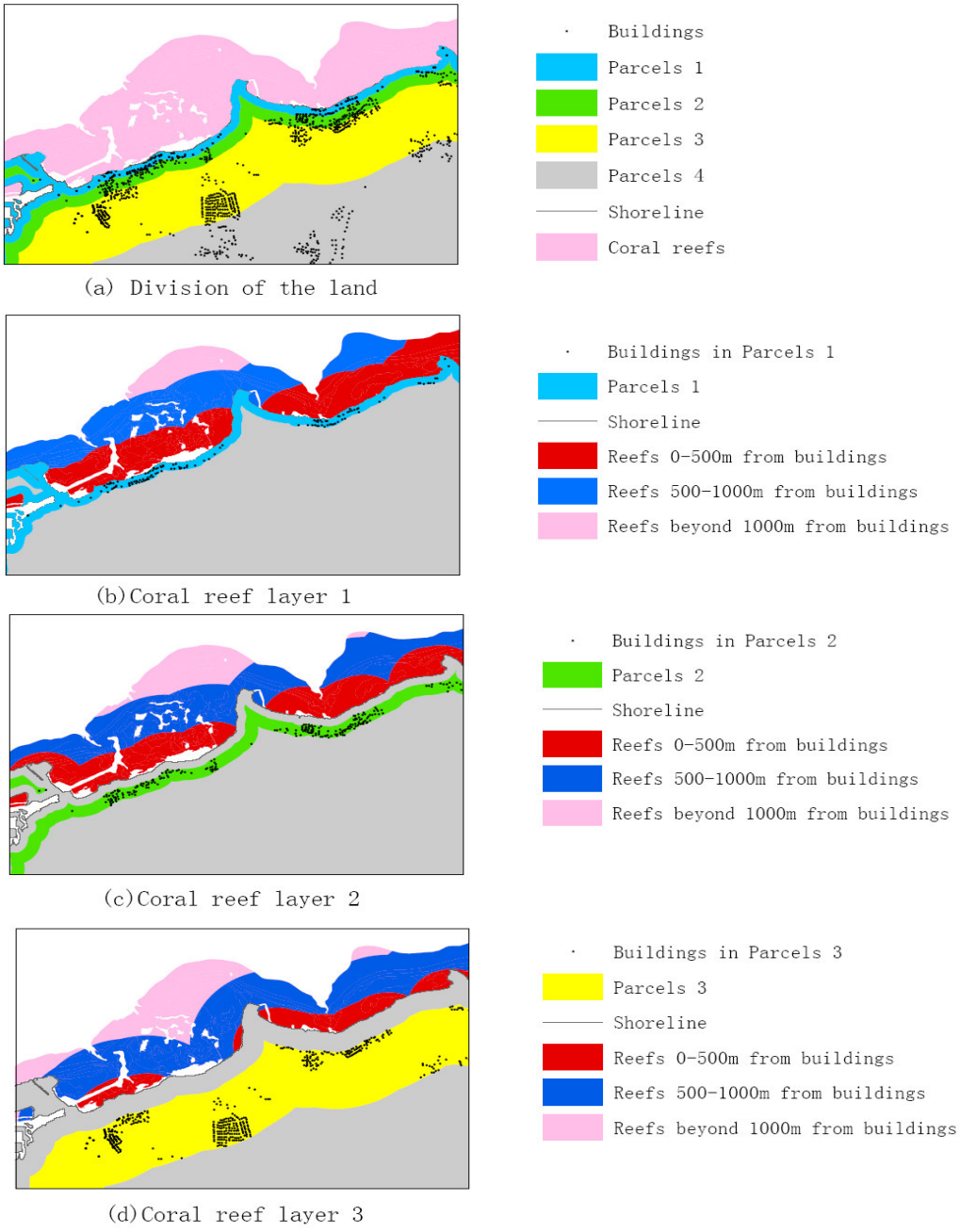


Figure 6.7 The method used in the distribution of amenity values of coral reefs

In addition, the area of each category was considered. The distribution of the amenity value in each layer was based on the proportion of the final score of each sub-category to the total final score of each layer. Categories and weights can be seen in Table 6.6. After allocating amenity values to every coral reef layer, the next step was to use GIS to overlay all these layers into one layer. Then the coral reefs were categorized according to the amenity value apportioned to them. The coral reef layer 1, 2 and 3 can be seen in Figure 6.8.

Table 6.6 Coral reef amenity value model used on Saipan (1st part)

Category	Sub-category	Weight	Area (km^2)	Score/total score
Reef layer 1	0-500m from parcels	0.7	3.76	2.632
	500-1000m from parcels	0.3	7.81	2.343
Reef layer 2	0-500m from parcels	0.7	3.05	2.135
	500-1000m from parcels	0.3	7.68	2.304
Reef layer 3	0-500m from parcels	0.7	1.83	1.281
	500-1000m from parcels	0.3	9.85	2.955

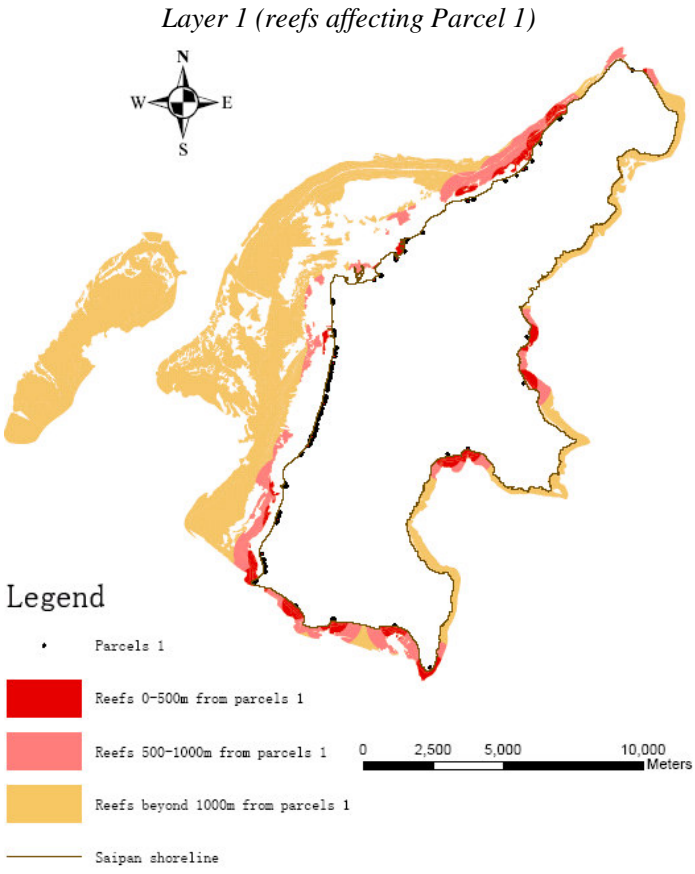
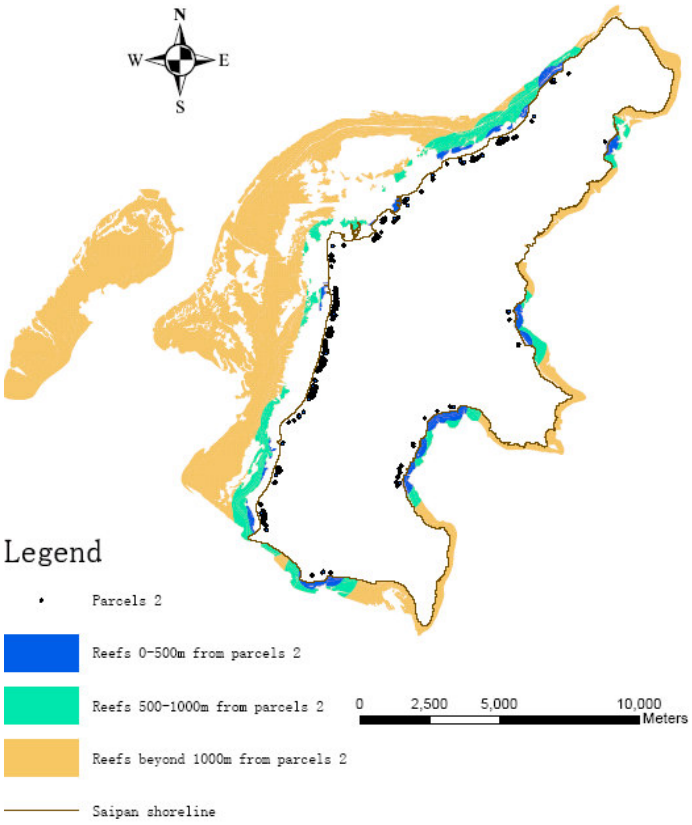


Figure 6.8(a) Coral reef amenities on Saipan (layer 1) - continued

Layer 2 (reefs affecting Parcel 2)



Layer 3 (reefs affecting Parcel 3)

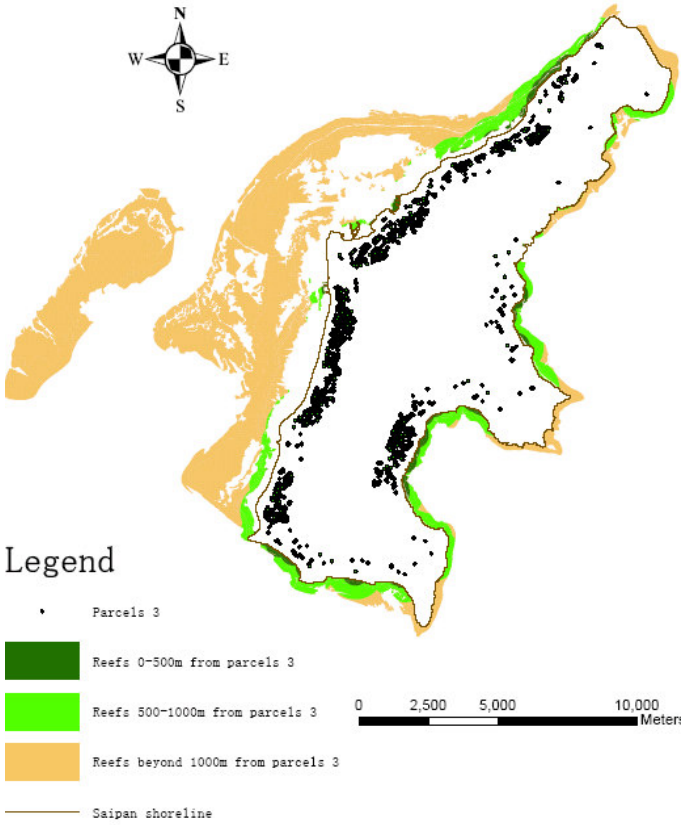


Figure 6.8(b) Coral reef amenities on Saipan (layer 2 & 3)

Monetary valuation

As calculated earlier, annual amenity values of Parcels 1, 2 and 3 are $0.81 million, $1.59 million and $0.6 million, respectively. Combining these values and the area of each sub-category, generated the results displayed in Table 6.7. Following the assumption that coral reefs closer to the coastline have higher amenity values, in each layer a 70% weight was attached to coral reefs located within 500 meters of the coastline and 30% was assigned to coral reefs within 500-1000 meters of the coast.

Table 6.7 Coral reef amenity value model used on Saipan (2nd part)

Category	Sub-category	Allocated amenity value ($)	Amenity value per unit area ($/km^2/year)
Reef layer 1	0-500m from parcels	426,886	113,532
	500-1000m from parcels	380,011	48,658
Reef layer 2	0-500m from parcels	766,225	251,222
	500-1000m from parcels	826,879	107,667
Reef layer 3	0-500m from parcels	181,444	99,151
	500-1000m from parcels	418,556	42,492

The next step was to overlay the three coral reef layers and add up the corresponding amenity values per unit area. The result is shown in Figure 6.9.

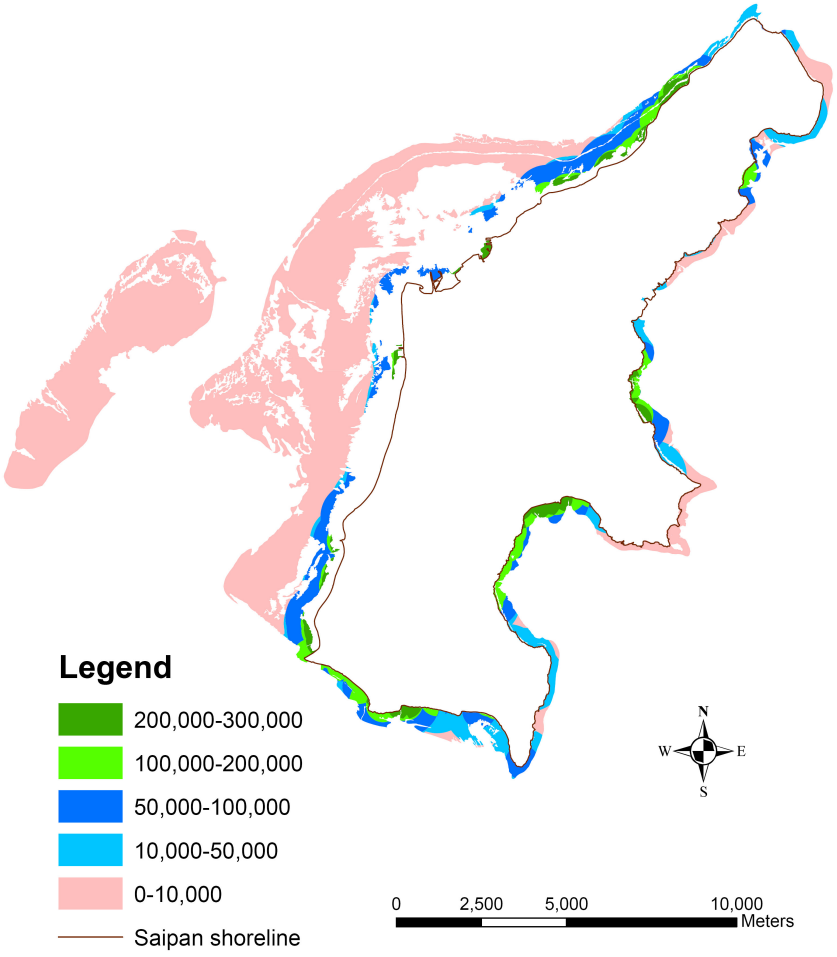


Figure 6.9 Coral reef amenity value on Saipan (in $/km^2/year)

6.5 Coastal protection

The principle used to determine the spatial allocation of the value of coastal protection is that without the protection of coral reefs, the waves and storm surges would reach higher elevations and cause more serious damage. The maps used include the elevation contour map of Saipan and a map in which the location of buildings on Saipan is shown.

Physical quantification

The method adopted to spatially value the coastal protection role of coral reefs on Saipan involved two main steps. First, GIS was used to analyze the potential damage caused by tropical cyclones (specifically caused by waves and storm surges), from west and east of Saipan. Tropical cyclones from different directions inflict different damage to the islands (Figure 6.11). For instance, the infrastructure and coastal properties located on the west of one island are subject to greater potential losses if the tropical cyclone hits the west of the island. One assumption requires specific attention: without the protection of coral reefs, the heights of waves and storm surges would be double. This assumption is based on the knowledge that the physical structure of coral reefs dissipates much of the force of waves: up to 77% in the case of discontinuous reefs, and more for continuous systems (UN Atlas of the Oceans, 2005).

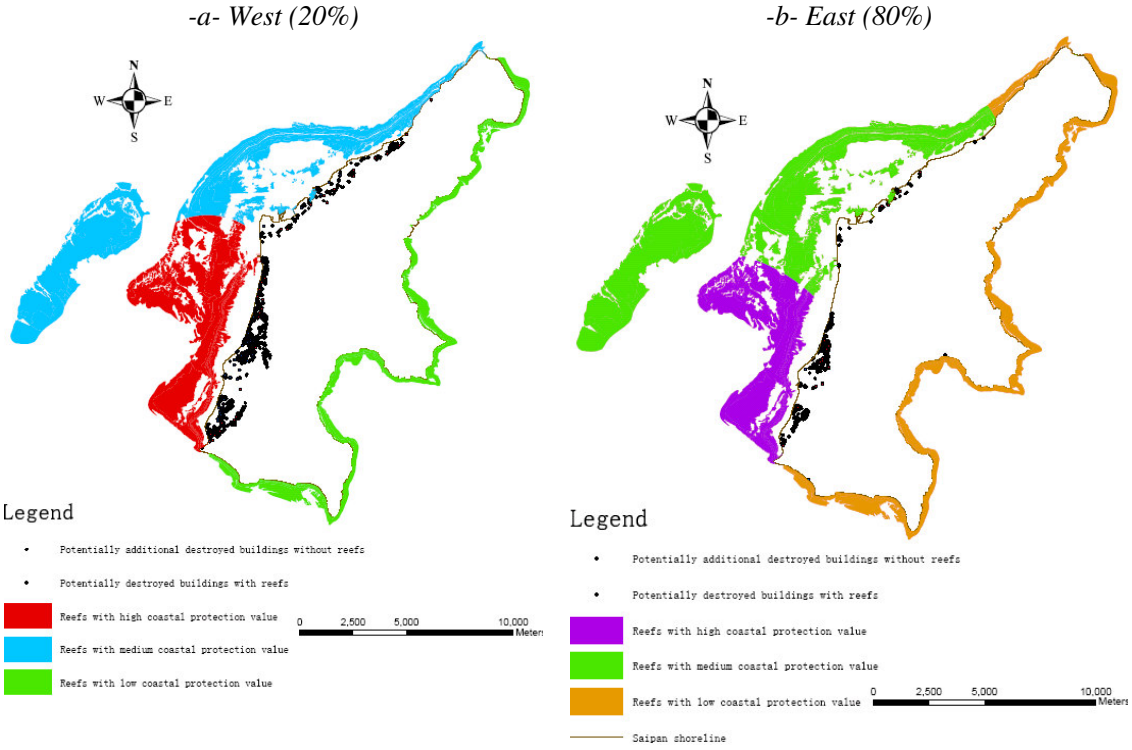


Figure 6.10 Potential damage to buildings on Saipan due to tropical storms from the west and the east of the island

The second step was to combine the results of the first step to produce the thematic map showing the spatial distribution of coastal protection values of coral reefs on Saipan. Taking into account the fact that most tropical storms on Saipan come from the east (80%) and only 20% from the west, we compared the coral reefs' coastal protection function for two situations: (1) storm damage *with* coral reefs present and (2) storm

damage *without* the protection of coral reefs. Potential heights of waves and storm surges with and without protection of coral reefs can be seen in Figure 5.14. As explained earlier, the situation without the protection of coral reefs is expected to cause the potential heights of waves and storm surges to double (compared to a situation with coral reefs). The detailed damage caused by tropical storms can be seen in Figure 6.10(a) and (b). Coral reef values were categorized according to the density of potentially vulnerable buildings. This meant that higher densities of potentially vulnerable buildings led to higher coastal protection values of coral reefs.

Monetary quantification

According to the previous calculation, under the 'without the protection of coral reefs' scenario, one substantial tropical storm from the west would result in extra damage worth around $2.41 million; the extra loss would be $1.63 million if the storm was from east (see Table 6.8). The process of assigning weights was based on the density of additional buildings that could potentially be destroyed. The greater the density of these buildings, the higher the coastal protection value of nearby coral reefs. 60% was given to the high coastal protection value of coral reefs, which meant these coral reefs can protect 60% of these vulnerable buildings. 30% and 10% were assigned to medium and low coastal protection values of coral reefs, respectively.

Table 6.8 Coral reef coastal protection monetary value model used on Saipan (1)

Tropical storm direction	Average loss each substantial storm (US$)	Probability	Sub-category	Weights
West	7,838,244	20%	High value	62%
			Medium value	31%
			Low value	8%
East	199,359	80%	High value	62%
			Medium value	31%
			Low value	8%

Following the same approach to that used to generate the other economic values, the combination of the relative scores with the gross economic value allowed for the estimation of the coastal protection values per unit of area (Table 6.9).

Table 6.9 Coral reef coastal protection monetary model used on Saipan (2)

Tropical storm direction	Weights	Area (km^2)	Score	Allocated value (US$)	C. protection value per unit area (US$.$km^{-2}$.$year^{-1}$)
West	62%	22.76	14.1	4,492,652	120,392
	31%	30.53	9.5	3,026,964	99,147
	8%	12.39	1.0	318,628	25,717
East	62%	17.36	10.8	111,558	6,426
	31%	19.89	6.2	64,043	3,220
	8%	28.43	2.3	23,758	836

After overlaying the two maps shown in Figure 6.10 (a) and (b) and adding up the corresponding coastal protection values per unit area, the coral reefs were re-categorized in terms of monetary value (see Figure 6.11).

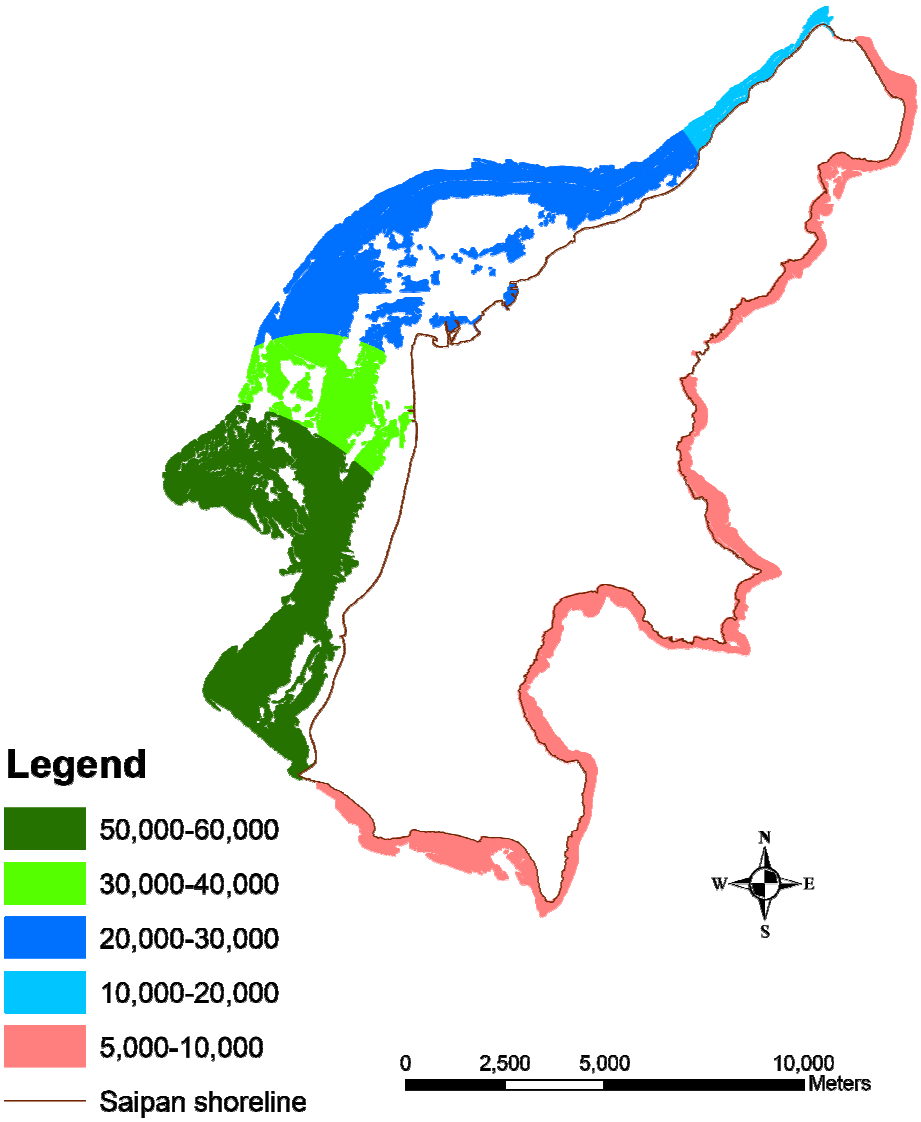


Figure 6.11 Distribution of reef coastal protection value (in $/km^2/year)

6.6 Research

The research value can be spatially allocated on the basis of a number of biological indicators, such as diversity, coral cover, 3-D structure, rareness, etc. Because the study has to rely on the available maps, the selected method to allocate the biological value in this study was based on the reef cover type, i.e. the dominant biological components of the coral reefs.[27] Following a report by the National Oceanic and Atmospheric Administration (NOAA), these cover types were defined in a collapsible hierarchy of eight major classes, combined with the percentage of the predominant cover type.

[27] The authors recognize that coral cover is a sub-optimal indicator, but as long as a map is lacking in which all biodiversity components are represented, we do not have a better alternative, but to follow this route.

Physical quantification

When determining the weights of cover types, cover types with higher rankings on the list of eight major classes were given higher weights. This method of biological valuation is based on the cover type of reefs. The benthic habitat map produced by NOAA supplied the information needed. Coral reefs can be divided into the several categories in terms of cover types and percentage cover of live coral.

Monetary quantification

The research value of coral reefs is around $0.79 million per year. The weights and categories can be seen in Table 6.10. With regard to assigning weights, 70% was given to reefs covered by living coral because they are more ecologically important and valuable than those covered by algae. 15%, 10% and 5% were assigned to coralline algae, turf algae and macro-algae, respectively.

Table 6.10 Biodiversity monetary model used on Saipan

Category	Weights	Reef area (km^2)	Score	Allocated value($)	Value per unit area ($.km^{-2}.year^{-1})
Living coral	70%	30.89	21.62	684,013	22,144
Coralline algae	15%	5.51	0.83	26,260	4,766
Turf algae	10%	21.21	2.12	67,072	3,162
Macro algae	5%	8.06	0.40	12,655	1,570

The map expressing the spatial allocation of the research value per unit area on Saipan is shown in Figure 6.12.

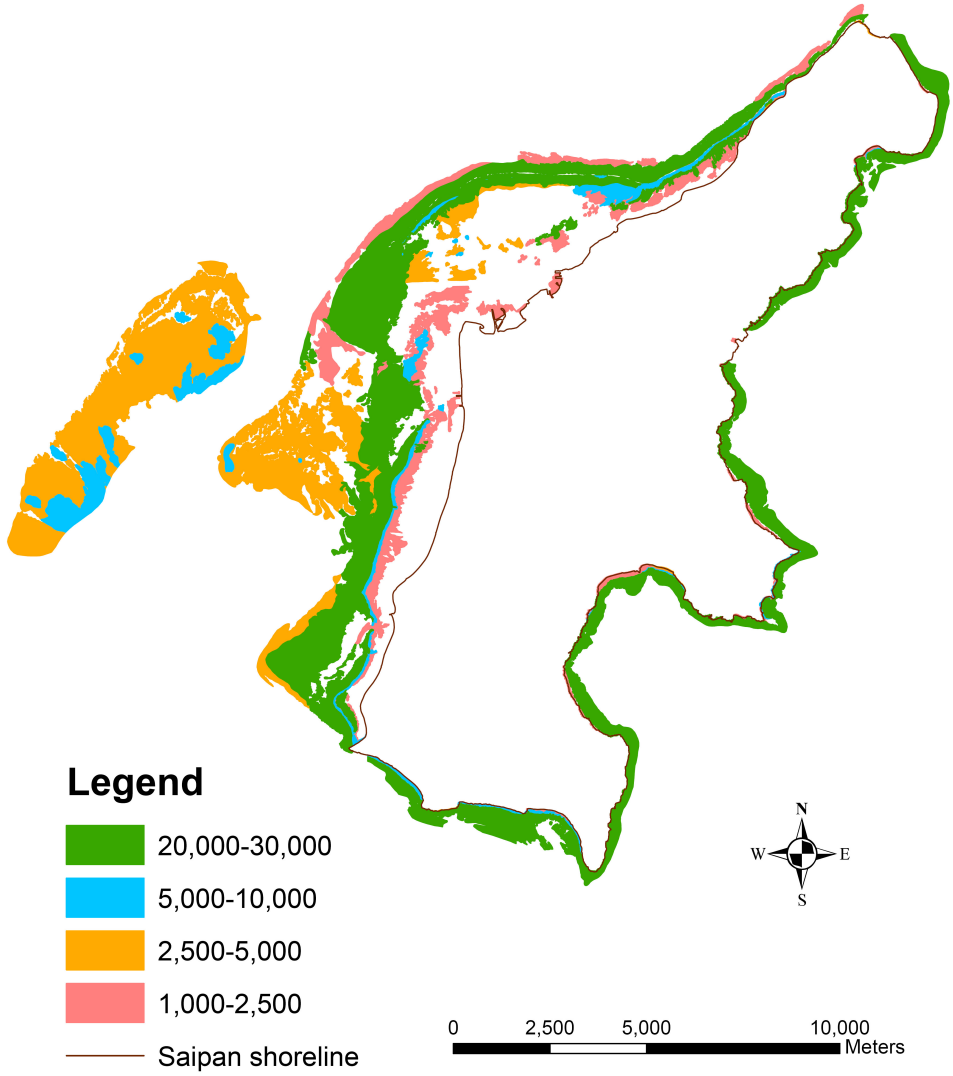


Figure 6.12 Coral reef research value distribution on Saipan (in $/km^2/year)

6.7 Synthesis

As demonstrated in the previous sections, coral reefs play a significant role in the economy and culture of Saipan. However, recent economic developments pose serious threats to the marine ecosystems on Saipan, thereby jeopardizing the economic benefits of coral reefs. Many of these threats can be avoided or minimized through effective policy interventions. However, due to a lack of financial means, only a limited number of potential interventions can be implemented. Therefore, a comprehensive selection tool is needed to help choose the most effective interventions. In this section, we demonstrate how this tool might be developed, using a combination of GIS and economic valuation.

Aggregation of economic values into Total Economic Value (TEV)

Earlier sections provided various value maps of the individual values of Saipan's reefs. To get a more general understanding of the variation in economic values between the different reefs, we created a map in which all five monetary maps are combined. Such an aggregation may be open to criticism, given that these values differ too much in nature

and size, and that combining them to produce one Total Economic Value (TEV) map is not scientifically sound. After all, some of the values are very explicit (i.e. divers revenues) while others are more implicit (i.e. coastal protection value). Nevertheless, one argument in favor of combining the individual values is that ultimately, they benefit the citizens of Saipan, and therefore they can be combined (see Figure 6.4).

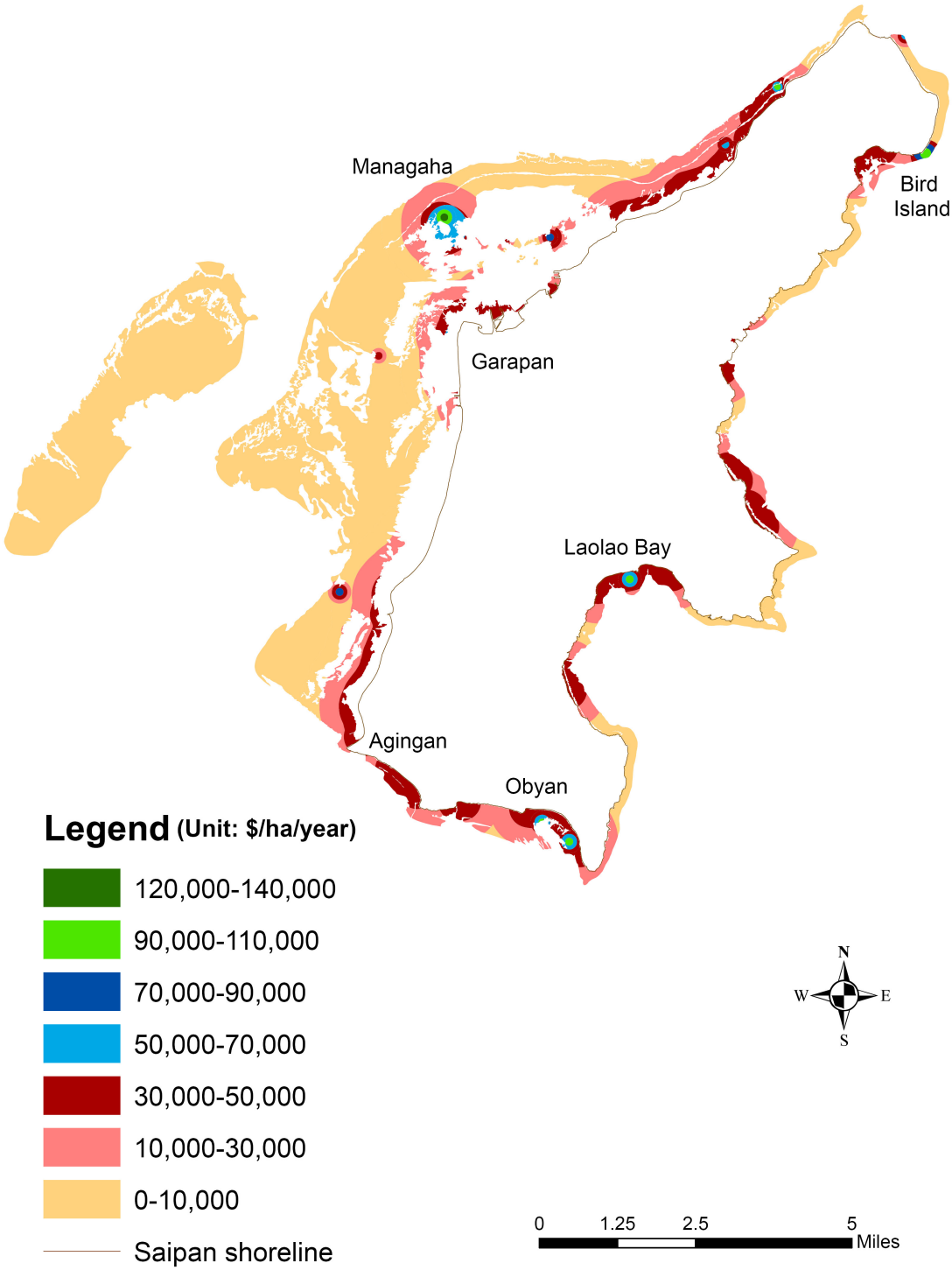


Figure 6.13 Total economic value of coral reefs on Saipan (in $/km^2/year)

Threats to coral reefs of Saipan

Saipan's coral reef ecosystems are under pressure from various types of human-induced threats. These threats differ greatly in nature and magnitude. A number of sources have been used to create an overview of the main threats to the coral reefs of Saipan. These include Wilkinson (2004), Houk (2001) and feedback from the Steering Committee of this project. It should be mentioned that these sources do not always coincide and sometimes even are in conflict.

Sedimentation and nutrient pollution affect many of Saipan's western and southeastern reefs. The development boom of the late 1980s and early 1990s left a legacy of over-burdened and failing sewage and solid waste management systems. Moreover, Saipan has numerous unpaved secondary roads that funnel soil and sediment into nearshore waters during heavy rain, increasing turbidity of coastal waters and occasionally smothering the reefs. Treatment of secondary roads with crushed limestone without addressing drainage problems created chronic sedimentation problems along Laolao Bay and Obyan Beach. The impact of two sewage outfalls on Saipan (i.e. Agingan and Puerto Rico) is also suspected to be detrimental to the reef. It is generally felt that the Sadog Tasi outfall is partially responsible for the poor condition of the reefs outside Garapan. The specific locations of these anthropogenic threats can be seen in Figure 6.14.

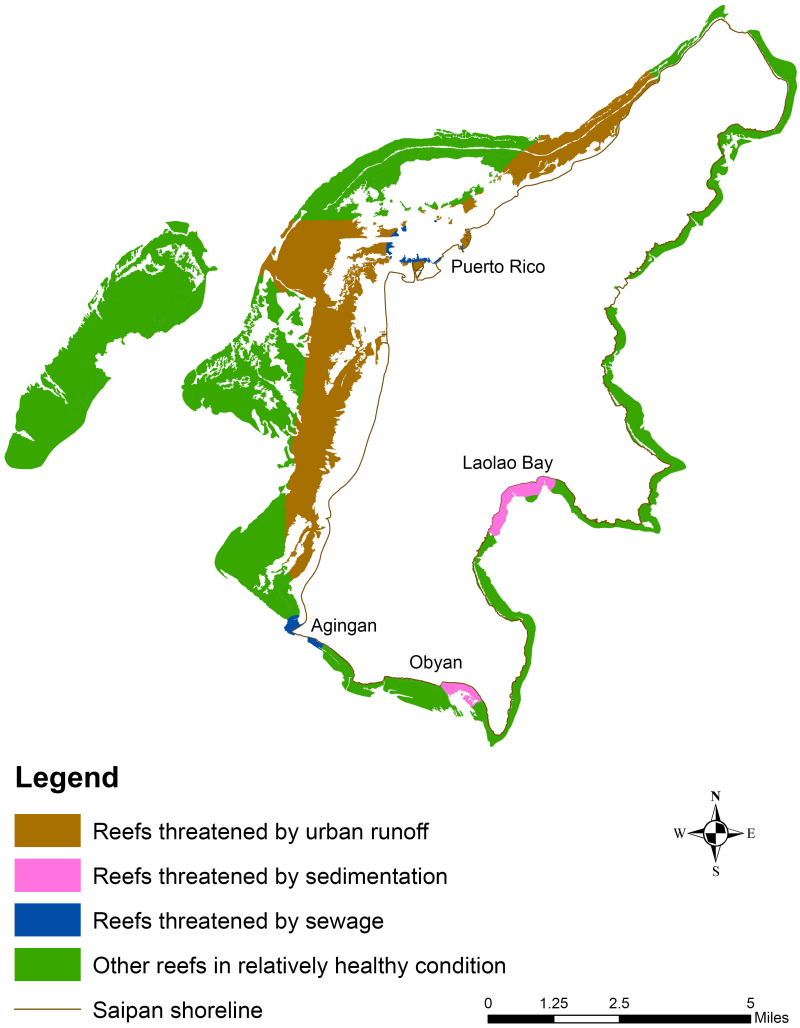


Figure 6.14 Anthropogenic threats to coral reefs on Saipan

Comparing TEV and threats

Having compared the distribution of total economic values of coral reefs (shown in Figure 6.13) and anthropogenic threats to coral reefs (shown in Figure 6.14), we conclude that, in general, more valuable coral reefs tend to be in relatively poor condition, and face more serious anthropogenic threats.

In terms of value per unit area, the most valuable coral reefs of Saipan are located to the west of this island, but their area is rather small. In terms of value per unit area, the most valuable coral reefs are located within 200 meters of the most popular diving and snorkeling spots (see Table 6.11). However, some of these valuable coral reefs have been affected by discharges and sedimentation from the land. These valuable coral reefs should be properly preserved to maintain their extremely high economic value.

The coral reefs located in the inner areas of Laolao Bay and Obyan Beach also have relatively high value and they are negatively affected by the sedimentation and sewage from the island. Coral reefs to the western coastline of Saipan also can be seen valuable in terms of economy, but their conditions are poor due to the sedimentation and sewage.

A positive observation resulting from the GIS analysis is that the coral reefs along the northeast of Saipan are having high economic value while still being in a relatively good ecological state.

In summary, the GIS analysis of the economic values and threats to the coral reefs on Saipan shows that coral reefs in the Laolao Bay, Agingan, Managaha and Obyan should get priority in terms of management. According to the GIS analysis, coral reefs located to the western coastline of Saipan also require further management efforts, albeit at a different level.

Table 6.11 Spatial variation of values of coral reefs on Saipan (in $/km^2/year)

Value category	Reef area (km^2)
Range $13,000,000-14,000,000	0.03
Range $9,000,000-10,000,000	0.18
Range $8,000,000-9,000,000	0.09
Range $6,000,000-7,000,000	0.40
Range $5,000,000-6,000,000	0.24
Range $4,000,000-5,000,000	0.63
Range $3,000,000-4,000,000	6.73
Range $1,000,000-2,000,000	10.25
Range $250,000-1,000,000	7.57
Range $0-250,000	39.56
Total	65.68

Note: a value of $1 million per km^2 is equal to a value of $1 per square meter

7. Sustainable financing for Marine Protected Areas

7.1 Introduction

Increasing pressure on marine and coastal ecosystems has led to the recognition that there is a growing urgency to protect and manage the resources that they provide in a responsible and sustainable manner. This requires managing the human activities that directly impact marine and coastal ecosystems, notably those associated with fisheries and tourism, as well as off-site activities resulting in pollution and sedimentation. In recent decades, Marine Protected Areas (MPAs)[28] have been established in various countries as a means of managing and protecting the marine environment. CNMI has also established several MPAs over time (see Figure 7.1).

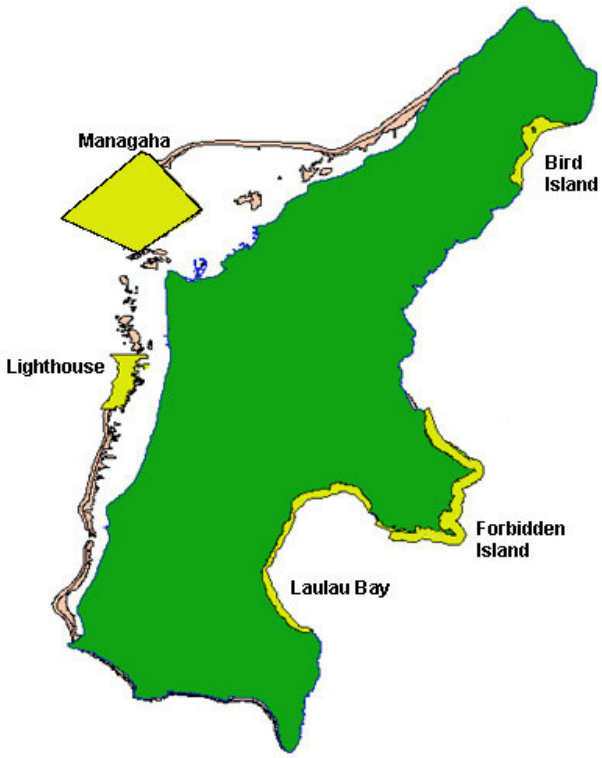


Figure 7.1 The MPAs of Saipan indicated in light green areas (Source: Coastal Resource Management website)

To manage MPAs, a sustainable financing structure should be established. In practice, the concept of sustainable financing is applied to correct the problem of lack of funding for the conservation and management of natural resources. In most countries, natural resources are a public good, which makes them susceptible to the free-rider problem. Free riding occurs when the conservation of a protected area generates costs, which are not covered by the beneficiaries of the ecological services. In this sense, the government,

[28] Marine protected areas (MPAs) have also been referred to as, among other things, marine reserves and marine managed areas.

the local communities and the international community are all beneficiaries of the goods from protected areas, but the costs are distributed unequally (Emmerton 2003).

This chapter provides an overview of several mechanisms for sustainable financing of MPAs worldwide. The concept of 'sustainable financing' is defined as a portfolio of diverse and stable financial mechanisms that contribute to the conservation of a protected area, covering operational and other costs with a combined option of short and long-term revenues. A sustainable financing strategy involves all the stakeholders that benefit or suffer from the ecological services of the natural area and its conservation.

It is important to emphasize from the outset that this chapter gives a preliminary overview only. For a concrete overview of the relevant sustainable financing mechanisms for Saipan, such as a business plan, a more detailed study will be necessary.

7.2 Background of sustainable financing

Marine Park Area (MPAs) have been defined as: "*Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment"* (Kelleher, 1999). MPAs exist on many different scales, ranging from small community-managed fisheries reserves of a few hectares to an area with a size of thousands of square kilometres. (Kelleher, 1999) suggests that MPAs can provide a number of benefits, the most important ones being:

- Conservation of biodiversity;
- Protection of habitats attractive to tourism;
- Increased productivity of fisheries, insuring against stock collapse, buffer against recruitment failure, increase in density, size, reproductive output;
- Increased knowledge of marine science through information;
- Refuge for intensely exploited species;
- Protection of genetic diversity of heavily exploited populations; and
- Protection of cultural diversity e.g., sacred places, wrecks and lighthouses.

Some of these benefits can be directly translated into economic terms, while others are indirect benefits that cannot be easily quantified. For instance, the gross recreational value of the Great Barrier Reef in Australia has been estimated at more than $0.5 billion (Driml, 1999). Also, fisheries benefits are potentially very large as well as the benefits from ecosystem services such as coastal protection. A recent study by White *et al.* (2000) estimated the economic value of the Olango Island Wildlife Sanctuary (40 km^2) in the Philippines and surrounding area. Sustainable annual net revenues of this area with reefs and mangroves were determined to be $1.5-2.5 million per year.

In order for the potential benefits of an MPA to be realized, in both economic and ecological terms, it needs to be effectively managed. Once this management issue is adequately addressed, the main question is how to 'capture' the estimated benefits in order to finance the cost of long-term effective and sustainable management. This sustainable finance question is the focus of this chapter.

It needs to be emphasized from the outset that there is an open debate as to whether sustainable financing through user fees and other payments by visitors is the correct way forward. Some scholars claim that it should be the government's responsibility to finance

the management of public areas, both on land and in the coastal area in order to guarantee that the poor are not effectively excluded from the use of such public areas (More, 1999). This is a valid point in case of relatively high fees for visitation of some of the public lands and national parks both in the US and in developing countries (More and Stevens, 2000). However, in the CNMI setting where only minimal charges are discussed, this is likely to be a minor issue, especially as the fee schemes considered exclude local residents from paying the fee.

7.3 Indicators of sustainable financing

For a scheme of sustainable financing to be truly sustainable, it has to meet with a number of characteristics. One of the characteristics is that a portfolio of revenue sources should be built. The combination of those revenue sources should create a stable revenue stream for the MPA. Another characteristic is the way the resources and the biodiversity are managed by an MPA and how the park's management deals with conflicts and reacts on surprises. Therefore, we considered it necessary to develop indicators of sustainable financing, based on the literature of indicators of sustainable development and of the financing of MPAs.

According to Parris and Kates (2003, 13.13) indicators serve the purpose of revealing the progress towards a goal of sustainable development, to advise the public, decision makers, and in our case MPA managers. The importance of indicators for management is that they can be used to identify possible policy responses, select priority actions and evaluate their effectiveness (ibid.). As a result, the following indicators are not given as a set of complete and definite criteria to evaluate sustainable financing, but as a guideline to analyze the situation of MPAs on CNMI.

Financial indicators

This set of indicators could help to analyze the financial assets of the financing strategy:

- Existence of a state-of-the-art business plan. There is agreement between conservation finance experts that the sustainable financing strategy must be part of a well elaborated business plan (Spergel and Moye 2004; Merkl *et al.* 2003; Quintela *et al.* 2004). The idea is that this business plan systematically could evaluate the long-term financial needs for operating MPAs and protecting the marine resources, as well as the possible financing options.
- Development of a portfolio of sources of financing. The MPA should have a broad portfolio of different financing sources. The different sources should cover both short and long-term needs. This would help in securing long-term funding for the main operations of the MPA, which is a key issue. (Quintela *et al.* 2004)
- Accountability. Ideally, the management creates the possibility of a financial independent evaluation of the execution of the funds. (Subijanto 2002)
- Stability of the revenues. The combined revenues should result in little variation from year to year. This means some independency from global and national economic, political and natural conditions. (Spergel and Moye 2004)
- Balance between costs and benefits. The revenues generated are ideally worth the cost of setting up the new financing system and cover the costs of the MPA. (Spergel and Moye 2004; Emmerton 2003)

- Cost sharing among the beneficiaries. It is desired that the beneficiaries of the benefits of the park bear the costs. This is also called the principle of the beneficiary pays. (Haerumans 2001)

Legal indicators

The legal indicators represent the optimal legal framework that allows the financing scheme to take place:

- The existing legal framework may support the finance options. It is good if the legislation of the country where an MPA is located allows the necessary money transfers. If the existing legal framework does not allow this, new financing mechanisms may be created by issuing an administrative or executive order. (Spergel and Moye 2004)
- There is a binding body of regulations for nature protection at an MPA. Legally enforceable regulatory instruments help to protect the biodiversity of the MPA. The effectiveness of regulations and their enforcement endorses nature protection and broadens the set of financial options. (Subijanto 2002)

Administrative indicators

The administrative indicators analyze the management of the park resulting from the sustainable financing strategy:

- Reinvestment of the revenues on the MPA. Money generated by different revenue sources of an MPA should preferably be reinvested in that MPA. Ideally it would be spent on enforcement, zoning, monitoring and staff training. (Spergel and Moye 2004)
- Effective management of the park is improved. With the financial mechanisms the administration of an MPA and its operations should strive to improve towards a more efficient and cost-effective protection of the MPA (Spergel and Moye 2004). This also means that the activities that take place at such an MPA should be controlled to not surpass the carrying capacity. Monitoring and evaluation would promote adaptive management (Haeruman 2001).
- Role and responsibility of stakeholders in park management. At best, each stakeholder, from donors to managers, to community users of the resources, has a clear role and clear responsibilities in the management of the MPA. They should contribute according to their abilities to the implementation of the sustainable financing strategy. (Spergel and Moye 2004)

Social indicators

Social indicators measure the acceptance of the financing structure from the local communities as well as the equitable distribution of benefits:

- Support from local communities. It would be optimal if communities perceive the financing structure as a benefit for their development. They should not see it as a threat to their traditions or to their sustainable use of the resources. When resources are used in a non-sustainable way by local communities, alternatives should be given for their development. (Spergel and Moye 2004)

- Portion of revenues assigned to local development. Ideally, funds will be applied equitably, being sensitive to distributional and wealth transfer issues where the conservation needs to restrict access to the resources by local communities. If losses occur, there should be adequate compensation and financial benefits for the communities concerned. (Quintela *et al*. 2004)
- Promote sustainable livelihoods. The financial mechanisms should develop a sense of ownership over the resources or products and promote livelihood alternatives that support marine conservation. It would be advisable to give individuals or groups a clear responsibility for the resources they use. (Spergel and Moye 2004)
- Capacity building of all the participating actors. Education and training for the participating actors in order to participate and benefit from the financial structure can be important, especially for those who have to transform their activities from unsustainable to sustainable resource use. (Quintela *et al*. 2004)

Political indicators

This set of indicators refers to the political attitude towards the sustainable financing instruments:

- Government support. It is beneficial if government supports the introduction of the new financing mechanisms and that it would be open to innovative ideas of MPA management. (Spergel and Moye 2004)
- Flexibility in the renovation of policies and legislation to adapt to new finance strategies. Where there is need to create new legislation and policies or to reform existing ones, flexibility and adaptability of the government and institutions play an important role. (Quintela *et al.* 2004)
- Independency from political changes. The stability of the financial mechanisms should strive to the highest possible degree of independency from political instability. (Spergel and Moye. 2004)

Environmental indicators

Environmental indicators are developed to analyze the impact of the sustainable financing strategy on MPAs resources and biodiversity:

- Support the conservation and protection of marine and coastal resources. The new financing mechanisms are developed to give an MPA the ability to fulfill its goal; to protect and conserve its marine and coastal resources. At the same time, the success of the conservation efforts influences the continued revenues from different sources. (Haeruman 2001)
- Promote research for conservation. Ideally in the financing strategy funding is considered for research on the MPA for conservation, sustainable use of resources and carrying capacity. (Quintela *et al.* 2004)
- New financing mechanisms do not have negative effects on the environment. The new financing mechanisms, for example tourist fees, should aim for a minimum compromise to the conservation objectives but should not exceed the carrying capacity of the MPA. (Spergel and Moye 2004)

7.4 Overview of revenue earning mechanisms for MPAs

Identifying and implementing appropriate financial mechanisms is especially important in situations where MPA management is hampered by lack of funds for monitoring, management and enforcement. Revenue generation can help the park to become a conservation success without being a financial burden to the government.

MPA's goods and services can generate considerable economic benefits, under the condition that investments are made in the management of the site. An MPA needs to diversify revenues using a range of financial mechanisms and approaches to generate stable, predictable and sustained income for conservation. Relying on one or a few sources of revenue is not sufficient to overcome the effects of fluctuations in income flows.

Revenues can broadly be categorized into: (i) those from users and (ii) those from non-users. Revenues from users include royalties, sales, user fees, taxation and licensing. The basic economic rationale for this set of funding sources is to capture some of the rent and willingness-to-pay associated with the use of the marine environment. Revenues from non-users include donations, bequests and business sponsorship.

The different revenue sources are described with the finance mechanisms that are mentioned later in this paragraph. Note, however, that sustainable financing mechanisms can serve different purposes for MPAs. They can provide economic incentives, increase the cost effectiveness of management, support compatible enterprise development to provide alternative income to local communities and generate incentives and resources for conservation. They can also generate essential income to cover monitoring and operating costs (Domeier 2002).

The most important financing mechanisms are described in this paragraph. These financial sources and mechanisms for revenue earnings are adapted from Spergel and Moye (2004); Quintela *et al.* (2003); United Nations Atlas of the Oceans (2005); UNEP (2001) and Morris (2002). To demonstrate that these mechanisms are not merely theoretical ideas, but are actually used in practice, real life examples are added for each mechanism. Appendix V provides a brief overview of these different instruments, and, moreover advantages and constraints are discussed.

Loan by multilateral development banks

Biodiversity conservation is increasingly benefiting from assistance by multilateral development banks, such as the World Bank and the Asian Development Bank. This funding is typically available only to governments as a loan for the establishment and maintenance of protected areas, often given in support of a national conservation plan. (United Nations Atlas of the Ocean 2005)

Example: USAID loan to Indonesia for $4.2 million to help the government in implementing policies that address the environmental issues of maritime transport[29].

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[29] Overview of South Asia USAID projects at http://www.usaid.gov/pubs/mdb/proposals.html

Grants and donations

A major source of funding for marine conservation is grants and donations from bilateral and multilateral donor agencies[30], foundations, NGOs, private sector companies, and individuals. Donors supply short-term funding, which can cover specific conservation needs in protected areas. (Quintela *et al.* 2003) This funding could be a regular part of the MPA budget or be managed through a trust fund. Note that countries could generally provide tax incentives for making charitable donations. It is possible to establish a Trust Fund that provides a yearly income to the MPA (see Box 7.1). An organization of 'Friends of the MPA' could capitalize on the goodwill of local residents and business people who want to help the MPA, as well as overseas visitors who want to maintain links with a place they have enjoyed visiting (Kelleher, 1999).

Example: The Galapagos National Trust receives considerable donations to help manage the Park.

Environmental funds

Environmental funds play an important role in supporting the long-term protection of biodiversity and protected area management. The types of environmental funds that are currently operating typically fall into three, not mutually exclusive categories (Quintela *et al.* 2003):

- *Endowment fund* where the capital is usually invested over a long period of time. The capital itself is never spent.
- *Sinking funds* which not only spend the income earned by investing the fund's capital, but also spend part of their capital each year.
- *Revolving funds* that rather than having a fixed amount of capital continually receive new revenues from user fees, earmarked taxes (keeping the money in the area) or other sources, and spend these revenues as they are received. In some cases, a small percentage of each year's revenues are transferred to a reserve fund.

Example: MesoAmerican Barrier Reef System (MRFM) has a long-term endowment goal of $25 million and will finance projects for the conservation and sustainable use of the reef (See Box 7.1).

Box 7.1 MesoAmerican Reef Regional Trust Fund (MRFM)

A regional financing mechanism is being established for the MesoAmerican Barrier Reef System, a unique marine ecosystem bordered by Mexico, Belize, Honduras and Guatemala. The MRFM has a long-term endowment goal of $25 million and will finance projects for the conservation and sustainable use of the reef. There are four country funds participating in the MRFM, including the Mexican Fund for Nature, the Protected Areas Conservation Trust of Belize (PACT), the Biosphere Fund (Honduras) and the Guatemalan Conservation Fund. The MRFM is being designed to fundraise, receive, manage and disperse funds to priority areas and projects for conservation of the reef. The mechanism will select funds and evaluate environmental projects

[30] International donor agencies include multilateral agencies such as the European Union (EU), United Nations Food and Agricultural Organization (FAO), Global Environment Facility (GEF), United Nations Development Programme (UNDP), United Nations Educational, Science and Culture Organization (UNESCO), and the World Bank (Spergel and Moye 2004).

for the reef under established guidelines and procedures. The fund is being capitalized with funding from the Summit Foundation, the IDB, and a WWF Donor. It will be set up as a private fund and decision on spending will be made by a board consisting of government, NGOs and other representatives. The fund's priorities will be based on the main threats to the area. It will provide funding to projects that address these threats in key biodiversity regions, including setting up and financing of MPAs.

Morris (2002) and references therein.

Debt relief mechanisms

Debt-for-nature swaps have been successful in generating long-term funding for conservation. Debt swaps are a method by which debt owed by a developing country can be renegotiated with creditors to fund nature conservation activities. Debtor countries can negotiate debt swaps with creditor governments (bilateral debt) or with the private sector (commercial debt). (Quintela *et al.* 2003)

Example: The Foundation of the Philippine Environment (FPE) is an endowment fund that was established through debt-for-nature swaps. From 1988-1993, WWF negotiated four commercial debt for-nature swaps in the Philippines, which generated a total of $27.3 million in conservation funds (Spergel and Moye 2004).

Government bonds and taxes

Government's power to impose taxes can be used in a variety of ways to raise funds for conservation and to promote conservation activities in general. Besides relying on general tax revenues to fund conservation, some governments have raised revenues for conservation by imposing earmarked taxes or selling interest-bearing government bonds (Quintela *et al.* 2003). Other taxes and fees are airport passenger fees and cruise ship passenger fees, hotel taxes and fines (Spergel and Moye 2004). After all, it can be argued that MPAs help increase the number of tourists and should therefore be supported by the increased revenues from bed and airport taxes. Furthermore, fees and levies can be imposed on certain activities, such as sale or purchase (Morris 2002 and from Nature Conservancy and UNEP 2001).

Example: The Minister of Finance of Trinidad and Tobago introduced a dedicated tax (levy) for the environment, which generated the equivalent of about $10 million per year. The Fund's management was subsequently transferred to the government Treasury and its potential beneficiaries were expanded to also provide funding for the public sector Environmental Management Agency. (Smith 2002)

Government appropriations

Funds appropriated in national or state budgets for protected area management (Morris 2002 and from Nature Conservancy and UNEP 2001).

Example: In the light of substantial underinvestment in ocean management in relation to federal spending on federal public lands and space exploration, the Pew Oceans Commission recommended that the U.S. Congress should at least double the funding for basic ocean science and increase funding spent on management of ocean resources by $2 to $5 billion annually. (Pew Oceans Commission 2003)

Marketing ecosystem services

Deriving funds from ecosystem services toward the conservation of protected areas and biodiversity can be a source of substantial untapped revenue. Innovative examples of creating markets for ecosystem services that provide incentives for conservation are selling carbon offsets, payments for watershed services and protection against storms and coastal erosion. (Quintela *et al.* 2003)

Example: The Clean Development Mechanism (CDM) allows industrialized countries to accrue credits in return for financing carbon reduction projects in developing countries that help further their sustainable development. Such projects must meet certain standards in order for carbon credits to be valid. Case studies of CDM forestry projects in Colombia, Ecuador and Brazil identify the significant financial opportunities for conservation through selling carbon offsets in the global market. (Quintela *et al.* 2003)

Real estate tax surcharges

The coast is often much more expensive than land elsewhere and is often owned by wealthy individuals or tourism-related businesses. Consequently, adding even a small fraction of 1 percent to existing real estate or property taxes has the potential to generate large amounts of money for biodiversity conservation and/or the acquisition of remaining open spaces to protect them from development. (Spergel and Moye 2004). This tax is defendable since healthy reefs are likely to have a positive effect on the value of the property as well, thereby creating concrete wealth for the owners.

Example: Residents of San Juan County on Puget Sound in the state of Washington require all purchasers of real estate in the county to pay an additional 1 percent real estate transfer tax; the San Juan County Land Bank Tax. (Spergel and Moye 2004)

Special governmental projects

Governmental agencies can set up special projects that generate money for conservation such as funding of earmarked projects; competitive grants, lotteries, stamps etc. (Spergel and Moye 2004)

Example: Dutch National Postcode Lottery is a popular charity lottery with ticket numbers based on the Dutch postal code system. Since it was founded in 1989, the National Postcode Lottery has donated the equivalent of over $1 billion to charitable organizations. (Stapel 2003)

Private sector investments

Business planning, venture capital investments, concession arrangements, private sector management of protected areas and voluntary contributions are examples of private sector investments. Private investments are generally a relatively minor source of funding for parks and conservation. For-profit investments also exist providing financial returns for investors while promoting conservation in a designated environmental zone (Green Funds) (Spergel and Moye 2004).

Three forms of private sector investments are explained in more detail.

Marketing goods and services: Legally binding agreements between the entity with authority over the protected area and private organizations or entrepreneurs who market goods and services related to the protected area and return some share of the profits, or a flat fee (Morris 2002 and from Nature Conservancy and UNEP 2001). *An example*: The Blue and John Crow Mountains National Park in Jamaica, where a NGO, the Jamaica Conservation and Development Trust, has entered into an agreement that includes collection of visitor fees (United Nations Environment Programme 2000).

Entrepreneurial Marine Parks: Governments can decide to contract out management and/or financial control to a private entity, such as an ecotourism establishment. This is sometimes referred to as an entrepreneurial MPA (Colwell 1999). Private entities can lease certain areas of high biodiversity with the aim of protecting biodiversity of these areas (Riedmiller 2000). Example: In the Netherlands, the Stichting Natuurmonumenten, the largest Dutch environmental NGO, owns considerable areas of land, wetland and cultural heritage sites, which it keeps under protected management.

Business venture: An MPA can be created through agreements between the local government and a private entity to balance conservation management and commercial feasibility. Operations follow commercial principles, but profit from tourism operations is re-invested in conservation activities, including, for example, education excursions for local schoolchildren. An example is Chumbe Island Coral Park Ltd. in Tanzania (see Box 7.2). This is an MPA that has been created through agreements between the local government and a private entity to balance conservation management and commercial feasibility. Local schoolchildren make educational excursions to the island. Another example is the collaborative management approach at the Komodo National Park in Indonesia (See Box 7.3).

Box 7.2 Chumbe Island: An example of private sector management of MPAs:

Chumbe Island is a small coral island of approximately 22 hectares off the coast of Zanzibar, Tanzania. It differs from most of Zanzibar because it was not plagued by heavy over fishing or blast-fishing, thus providing a rare chance for coral reef conservation. The island was uninhabited and faced little immediate threat from human activities. Chumbe Island Coral Park (CHICOP) was established in 1991. Revenue for running the park is generated from diving, snorkeling, glass-bottomed boat trips, nature trails, accommodation and restaurant services.

An economic analysis carried out in 1998 estimated the overall investment by then to be almost $1.2 million, of which $220,000 were grants from a variety of donors for several non-commercial project components. Roughly $600,000 was spent on conservation, $100,000 on education and $500,000 on tourism infrastructure. In 2000, the third year of commercial operations, the Chumbe project still wasn't break-even, mainly due to a lower occupancy rate than required. The project is, therefore, maintained with very cost-conscious operations and has required continued volunteer support. This data shows the challenges for entrepreneurial MPAs in their initial years of operation. Still, as a sign of its success, CHICOP has won various awards, including the prestigious 2000 UNEP Global 500 Award.

Source: Riedmiller (2000).

Box 7.3 Komodo National Park Collaborative Management Initiative (KCMI)

Komodo National Park (KNP) is embarking on a collaborative management approach, involving all key stakeholder groups in the management of the protected area. These include the park authority (PHKA), local government, a Joint Venture between an international NGO (The Nature Conservancy - TNC) and a local tourism company (JPU), as well as local communities, government agencies, and private sector organizations. A tri-partite collaborative management agreement between the Joint Venture, PHKA and the local government is being developed to set out of the three bodies' responsibility for conservation management, monitoring and enforcement and sustainable livelihood activities. PHKA will maintain a role in park management, but only through separate collaborative management agreements. The involvement of local communities will be assured through their representation in the Community Coordination Forum.

The Joint Venture (JV) has been established as a not-for-profit company whose charter directs that any profits earned will be invested back into conservation. This will give the JV due respect among other commercial bodies in involved in the area, while maintaining its credibility as an institution with conservation as its bottom line. A business plan for the JV has been completed. It has applied for a 30-year tourism concession from the Ministry of Forestry, which authorizes the JV to collect gate fees, establish and implement carrying capacity limits, and develop a tourism licensing system. The JV has applied for long-term funding from GEF/IFC to set up this tourism concession. This represents a groundbreaking policy experiment for the government of Indonesia and for management of protected areas in general. The rationale behind the agreement was based on a proven track record of each partner investing in KNP, as well as the complementary agendas of the conservation NGO and the tourism-oriented private sector company. Over time, as the concession becomes more established, the JV plans to move toward co-management arrangements with local communities and local government.

In the long-term, the KCMI plans to bolster the limited capacity of PHKA to protect the resources of KNP and to make it a self-financing park, with tourism revenue covering management costs. The government, TNC and other partners have developed a 25-year management plan for KNP. In addition, an analysis of economic issues, a community enterprise assessment and a comprehensive tourism study have taken place, all contributing to the establishment of the concession. Positive and negative incentive mechanisms will be used to ensure the sustainable use and protection of the resources. These include: a micro-enterprise fund for local family-based businesses, research and development of sustainable methods of marine resource use, and a community development grant to finance urgent welfare needs. Regulation and fines systems will also be put in place and/or strengthened.

Source: Morris 2002 and Gallegos *et al.* 2005

Fishing industry revenue

Governments can raise revenues to manage fishing in MPAs by charging fishing payments, license fees, excise taxes and fines. They can charge levies on the commercial fishing industry and ask for fishing access payments. The protection of biodiversity contributes also to fish populations and fishing industry benefits from this spill-over effect. Instruments are tradable fishing quotas, fish catch and services levies, eco-labeling and product certification, fishing access payments and fines for illegal fishing (Spergel and Moye 2004)

Example: In St. Brandon the local fishing company has a license that sets conservative quotas for the Cargados Carajos Shoals. See Box 7.4 for more detailed information.

Box 7.4 Fishery License to preserve healthy fish stocks – the St. Brandon case

Almost 400 km north of Mauritius lays St. Brandon, also known as the Cargados Carajos Shoals. It consists of a shallow area some 60km long and 25km wide with 55 sand cays and vegetated islands, lagoons and coral reefs. Only two islands are inhabited, both by fishermen working for one company. The area has been identified as an area of regional importance for marine biodiversity conservation (Kelleher *et al.* 1995). St. Brandon has an intact marine fauna due to prudent exploitation by the licensed fishing company that sets conservative quotas and only fishes part of the reef, thereby indirectly establishing MPAs that act as 'sources' for adjacent areas. As the company holds a permanent fishing license and lease on 13 islands, and a renewable lease on 15 more, it has a long-term interest in exploiting the resources sustainable.

The key to its successful maintenance of healthy fish stocks lies in the area-based management system adopted, and the company's long term interest in maintaining the resources. This is possible because of the absence of competition. A management plan prepared recently for the area by the World Bank recommends the fishing company as the guardian of the archipelago, to protect not only the marine, but also the terrestrial resources (mainly birds and sea turtle beaches). The remoteness of St. Brandon would render it impossible for the Mauritian government to protect it. Periodic monitoring would be carried out and extension of the renewable lease by the government would be dependent upon the effectiveness of protection. To expand the basis for revenue generation, boat-based (live-aboard) ecotourism is recommended.

Source: (Cesar and Westmacott, 2001).

Tradable permits

Tradable permits can regulate overuse of limited resources, for example by divers who can actually degrade the resource instead of contributing to its sustainability. Such a system was studied by Cheryl Ann Cumberbatch as part of her MSc. dissertation at the University of York (UK) and discussed in Morris (2002). Such a permit system[31] should provide incentives for sustainable diving within an MPA, giving the users (dive operators) a sense of ownership over the resource. This system has not been tried for MPAs, but works in many other situations where scarce resources need to be allocated.

Example: The use of the tradable permit system is usually limited to hunting recreation. It is nevertheless worth exploring the possibility of using this method for managing other types of ecotourism such as sightseeing, fishing or exploring the wilderness.

Biodiversity prospecting

Contracts in which a pharmaceutical company or other entrepreneur secures right to genetic resources (biological materials collected and processed for analysis) in return for cash payments and/or royalties on any medicines or products developed (Morris 2002 and from Nature Conservancy and UNEP 2001). Biodiversity prospecting is an interesting new revenue generation mechanism for the conservation of biodiversity.

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[31] A tradable permit system should: (a) issue different types of well-defined permits for different sites, (b) limit these permits to ecologically sustainable levels, thus giving them a value that can be accurately estimated, (c) make the permits freely tradable with limited restrictions on the scope of trading, (d) minimize the transaction costs involved in the trading, (e) enforce penalties for violating a permit (that penalty being greater than the permit price), and (f) enable producers to retain any profits they earn from trading (Cumberbatch, 2001)

Large global markets exist for products derived from genetic resources. The sea, and in particular the coastal shelf, contains remarkably high species diversity, and MPAs are often coastal areas with a relative abundance of such diversity. Compensation can be realized in a number of ways, e.g. rental fees, rural employment, profit share, licensing fees, international technology transfer, tropical disease research, royalties and joint venture agreements (Putterman, 2000).

Example: In 1992 the Coral Reef Foundation entered into a five-year contract worth $2.9 million for the supply of reef samples to the US National Cancer Institute for use in cancer and aids screening programs (See Box 7.5).

Box 7.5 Capturing the commercial value of coral reefs through biodiversity prospecting

International commercial interest can also be translated into funding, as evidenced by the use of payments for coral reef prospecting rights as a means of generating income for marine conservation. A number of useful medical and pharmaceutical applications of coral reef species have been discovered, and many more are under development, e.g. compounds against cancer, treatments for heart disease, sunscreens and bone graft substitutes. There is a high level of international commercial and industrial interest in this potential. In line with this interest, Imperial Chemical Industries has acquired the rights to develop a number of reef pigments for use as sunscreens for humans, and in 1992 the Coral Reef Foundation entered into a five year contract worth $2.9 million for the supply of reef samples to the US National Cancer Institute for use in cancer and aids screening programs.

Source: Morris (2002) based on Spurgeon and Aylward (1992).

Community-based initiatives

Initiatives such as fishing concessions and sustainable resource use to generate revenue at the local level. The local community interests include the long-term availability of funds for protected areas, and equitable distribution of the financial and non-financial benefits generated by MPAs. (Quintela *et al.* 2003; United Nations Atlas of the Oceans 2005)

Example: The Annapurna Conservation Area Project of the King Mahendra Trust for Nature Conservation in Nepal fosters greater community involvement to protect the local resources, providing local skills and traditional knowledge, and replacing the high cost of deploying army personnel for patrol.

Tourism-based revenues

New approaches of tourism user fees allow greater retained earnings, with fees depending on the type of the visitor (foreigner, local, student, etc.), the type of visitor activity (protected area entry fees, diving fees, fishing license fees, and yachting fees), length of stay, season, revenues from commercial activities of protected area agencies and voluntary donations of tourism operators or tourists (Quintela *et al.* 2003).

Four forms of tourism-based revenues are described in more detail.

User fees: Those include entrance fees, diver fees and yacht mooring fees among others. They could be defined as any charge for non-consumptive use or visitation of an MPA (usually ‘per person’ or ‘per vehicle’); may be daily, seasonal or annual and may be

charged to tour firms bringing escorted groups (Morris 2002 and from Nature Conservancy and UNEP 2001). In many Parks, locals are not charged or are charged less than foreigners (Thailand, Indonesia, etc.) or out of State visitors (Hanauma Bay, Hawaii) in order to combine 'cost recovery' with provision of 'maximum opportunities for learning and appreciation' by locals. Different uses can also be charged differently. Appendix II gives an overview of user fees around the world, based on Lindberg and Halpenny (2001).

Example: Bonaire Marine Park can finance itself through the collection of user fees (See Box 7.6).

Box 7.6 Bonaire Marine Park – self-financed through user fees

Bonaire is a small island (288 km^2) situated in the Southern Caribbean. It is surrounded by fringing reefs that are easily accessible and have provided the island with a valuable resource for the tourism industry. The accessibility of the reefs also makes them vulnerable, being so close to shore, the reefs are affected by runoff from land, poor wastewater disposal, and seepage from septic tanks and overflow systems. The Bonaire Marine Park (BMP) covers the marine environment from the high water mark down to 60 meters and includes all 2700 hectares of coral reefs, mangroves and seagrass beds. It is a multiple use park with fishing and diving restricted to certain zones. It was established in 1979 with initial start-up funding for 4 years, which enabled a mooring system to be installed. The park functioned until funds ran out and, although supported by dive operators, it became little more than a 'paper park'.

BMP was revitalized in 1991 under the condition that the park had to be self-financing within a new 3-year term of funding. Self-financing was achieved by the end of 1992 when a $10 diver fee was introduced. The park has almost managed to eliminate destructive practices such as anchoring, spear fishing and coral collecting.

The income generated from the $10 diver fees through the sale of the diver badges (tags) covers the salaries and operational costs of the park. The BMP staff includes a manager, 4 full time rangers and three administrative staff who are shared with the Washington-Slagbaai terrestrial park. Operational costs include boat and vehicle maintenance and running costs, the maintenance of the 70 public dive moorings, research and monitoring programs and educational activities for the local children and teachers. For specific projects, the Park has to look to grant funding agencies for support. Income from divers has gradually increased as the number of divers has been increasing, while the $10 fee remained in place until fairly recently, when it was raised to $25. Earlier studies in 1991 showed that the fee could be increased, and that tourists would still be willing to pay.

Source: Dixon *et al*. (1993).

Tourism operator certification: The certification of tourism operators provide an incentive for tourism operators to invest in environmentally sustainable operation since consumers undertaking nature-based tourism often seek out certified or recognized destinations (Spergel and Moye 2004).

Example: Major certification and award programs are the Green Globe 21, the World Legacy Awards and the Blue Flag.

Sale of goods and services: This is a form of revenue generation whereby a percentage of earnings from activities or products connected to the MPA is collected by the MPA e.g. gift and souvenir shops, sale of items such as maps and guides, books, photographs,

postcards, films, fee-for service tours, anchorage, mooring, equipment rental, camp or picnic space rental, exhibit entry, etc. (Morris 2002 and from Nature Conservancy and UNEP 2001).

Example: The Seychelles Marine Parks receives revenue among others from selling coco-de-mer and tortoise (See Box 7.7).

Box 7.7 Revenue generation from sales of goods and services in the Seychelles MPAs

The sale of tickets to tourists for entry into the Marine National Parks, boat mooring fees, filming fees, sale of coco-de-mer and tortoises, and hiring of picnic facilities form the basic revenue of the Seychelles Marine Parks. In 1997, the total revenue of the parks was Rp.1, 990,058. Of this, 70% was derived from the user fees and less than 1% from the other forms of revenue generation mentioned above. 68% of this revenue was derived from 2 of the 5 parks which thus subsidized the running of the remaining 3 parks. The central management of the parks by the Seychelles Marine Parks Authority has resulted in cost cutting due to the sharing of administration expenses. Note however that the wildlife products for sale have to be sustainably harvested and managed.

Source: Mathieu (1998).

Cause-related marketing: Sale of mostly intangible items (membership, voluntary add-ons to hotel and restaurant bills, etc.) - primary value is purchaser's knowledge of helping conservation (Morris (2002) and from Nature Conservancy and UNEP (2001)).

Example: In the United Kingdom a company called Pizza Express promoted a fish pizza, which has generated a large amount of media publicity, and raised 100,000 British pounds for a Marine Nature project, and vastly increased product sales.

7.5 Other issues

There are other general issues, which are relevant for the sustainable financing of MPAs, but which are not financial mechanisms itself. The first is the concept of a network of MPAs, whereby the objective is to combine high revenue MPAs with MPAs that cost money in order to be able to protect all kinds of marine ecosystems. Another effective management option is to reduce the costs of an MPA.

Network of MPAs

In several instances, ecologically integrated networks of MPAs are established. Some of these MPAs within a network may have excellent revenue generating potential while others do not. This may be due to its remote location or inversely, the ease of access. In such cases, sustainable financing options can be considered for the network as a whole; for instance, MPAs can cross-subsidize each other e.g. where one MPA is the 'cash cow' for management of the entire network of MPAs. This can ensure that even those MPAs with limited options for a diverse portfolio of financing mechanisms are able to cover their basic costs, besides this form of cross-subsidizing, costs can be shared through sharing of staff, technical expertise and monitoring responsibilities (Morris, 2002). An example is the Kisite-Mpunguti MPA complex in Kenya (see Box 7.8).

Box 7.8 Unequal distribution of benefits in the Kisite-Mpunguti MPA complex, Kenya

The high economic benefits associated with the Kisite-Mpunguti MPA complex (KMMPA) provide strong justification for its status as an MPA, and demonstrate that, in theory, the park is an economically appropriate use of natural, financial and human resources. Yet, support for marine conservation is low around KMMPA, and park management is difficult in practice. The major issue in KMMPA is the unequal distribution of benefits between the different stakeholders. The groups who bear the major direct costs and opportunity costs (i.e. foregone benefits) associated with the MPA (KWS and local communities) receive a disproportionately small share of the benefits generated, while major beneficiaries (private sector tour operators) bear few of the costs associated with management.

More than 3,000 people live on Wasini Island, alongside KMMPA. Almost all primarily rely on fishing for their livelihood. The majority of these people lose out in economic terms from KMMPA, because they have been excluded from their traditional, highly productive fishing grounds in Kisite. These losses far outweigh the local gains from the park in terms of tourist-related income and improved fish productivity. Despite a requirement for visitors to Wasini Island to pay a small fee to the village authorities, only one private tour operator attempts to abide by this arrangement. Even when operational, the improved gains from the benefit-sharing arrangements did not balance the local losses incurred. Most community members will continue, in the absence of tangible economic benefits, to regard KMMPA as an economic liability rather than an asset, and to feel a high level of antipathy towards both KWS and private sector tour operators.

Source: Emerton & Tessema (2000).

Cost effective management

Cost effective management options can greatly reduce the need for revenue generation for park management. In particular, they can lower the costs of managing MPAs by sharing the costs and benefits of management with local stakeholders. Examples are the maintenance of mooring buoys by dive operators, decentralization of fishing regulations to local communities, volunteers and/or other interest groups, fee collection and even monitoring.

Example: The collaborative management agreement in St. Lucia between the government and a community institution with the capability of managing a marine protected area and administering a fee system. Fees raised will be placed in a separate government fund, which will make quarterly payments to the community institution for the management of the protected area (Salm *and Clark* 2000). An example of co-management in Fiji is given in Box 7.9.

Box 7.9 The Ucunivanua Project: benefits from involving communities in co-management

In the early 1990s, residents of Ucunivanua Village in Fiji recognized that the marine resources they depended on were becoming scarce. In the past, village elders recalled collecting several bags of large kaikoso (a clam found in the shallow mudflats and seagrass beds) in a few hours. However, by early 1990s, a woman could collect only half a bag of small clams after a full day on the mudflats. One solution identified by the community was to return to their traditional management practice of setting up tabu areas – regions that were temporarily closed to fishing to replenish stocks. They experimented by setting up a 24-hectare tabu area on the mudflat and seagrass bed in front of the village. A management team was assigned to stake out the area and, with assistance from a team from the University of the South Pacific and the Biodiversity

Conservation Network, developed and implemented simple monitoring methods. The management team monitored the site twice in the first year and annually thereafter. The results showed an increase in numbers and size of clams, in some cases, the biggest clams found in three generations. Due to the work involved and the encouraging results, the entire Ucunivanua community became interested in the tabu area and, once they saw the effects of the tabu area, they decided to set up other tabu areas in mangroves and coral reefs to protect one species of mud lobster, several species of sea cucumber and several coral reef fishes and invertebrates, all of which were of some economic or cultural value to the village members. The Ucunivanua community is considering converting some of these temporary tabu areas into permanent no-take sites. Other communities across Fiji soon expressed interest in setting up their own tabu areas, and customary marine reserves are now being set up at four other sites across Fiji. The Ucunivanua project also influenced government policy. The government policymakers are now planning to adopt traditional Fijian customs to manage marine resources and have a full-time program focusing on locally managed marine reserves within Fiji's coastal waters.

Source: Morris (2002) - originally from Tawake *et al*. (2001).

7.6 User fees

There has been a global trend of protected areas covering a larger percentage of their operating budgets from protected area-generated revenues (Eagles 1999) such as user fees. A user fee system should reflect the economic value of recreation services and fund conservation of protected areas. The justifications for levying visitor use fees are cost recovery and revenue generation. According to Brown (2001) the fee should cover the costs of each individual visit in order to maintain protected areas in proper operating order. The benefit of a user fee system is that the revenue gained is more easily quantified then with other financing mechanisms (Sherman and Dixon 1991). The revenue generated is received per visitors of the protected area, thereby serving a dual purpose, namely of generating money and managing (or limiting) access by visitors (Brown 2001). Therefore these fees are a potentially powerful tool to move towards greater efficiency, equity and environmentally sustainable management, although this tool is commonly under exercised (Laarman and Gregersen 1996).

However, for protected areas with low visitation, the user fees may not generate sufficient revenue; the fee collection will be too low to cover the operational costs, unless the fee is aimed at high value tourism. People from higher income classes generally tend to have a willingness to pay higher then people from lower income classes (Mackintosh 1983). Therefore it is essential to take a closer look at the kind of tourist that arrives on Saipan (bearing in mind, however, the tourist with a higher income level may also expect more service and luxury accommodation). It could be necessary to invest in the accommodation and services the MPAs offers to visitors. Either way, a 1996 study by More *et al.* examined the effect of fees on U.S.-based campers' expectations and behavior and concluded that the public wants to know they are getting something for the money they spend.

The advantages of user fees are that the public appreciates service more if they have paid for it (Ibrahim and Cordes 1993; Binkley and Mendelsohn 1987). Also fees allow regulation of the access by visitors (Ibrahim and Cordes 1993). The use of fees can make the MPA self-sufficient and thereby encouraging realistic market-based pricing so that the resource exploitation will be limited. Pricing of a good below its market cost

encourages exploitative use by its users (Manning *et al.* 1984). Self-sufficiency also encourages managers to provide attractive services to the public and maintain parks in good condition (Leal and Fretwell 1997). Another advantage is that the beneficiary pays for the benefits he or she receives (comparative equity) (Manning *et al.* 1984). And self-sufficient MPAs do not need to cater to politicians and special interests (Leal and Fretwell1997).

A disadvantage of a user fee system is that the use of fees transforms the social role of manager and visitor into sellers and buyers. This type of shift could create a MPA that responds to the visitor instead of the society as a whole (Crompton 1998). For example poor people can get excluded from enjoying the MPA. On the other hand double taxation can take place; tourists can be charged taxes for hotels and other services and for a user fee.

Type of user fee

In the previous paragraph term user fee is operated in a general way. Some advantages or disadvantages can be overcome by the use of specific types of user fees. In this paragraph the results from a research of the types of fees used at 53 nature parks worldwide are described. See appendix VII for the parks involved in the desk research.

We distinguish five main categories of user fees: i) entrance fees (the most common type of fee)ii) fees that are charged on the basis of an activity; iii) fees that are charged for the use of a private vehicle; iv) fees charged to the commercial operator (e.g. guided tour) and v) fees charged for an overnight stay.

Figure 7.2 shows the percentage of different type of fees used in the researched parks. Note that one park can use more then one type of user fee. 83% of the 53 researched parks use an entrance fee, 43% use a fee for execution of an activity, 17% levy a fee for the use of a private car or vessel, 21% charge commercial operators a fee, and 25% of parks charge a fee (next to the rate of the accommodation) for an overnight stay, (although not all investigated parks have the capacity for people to stay overnight).

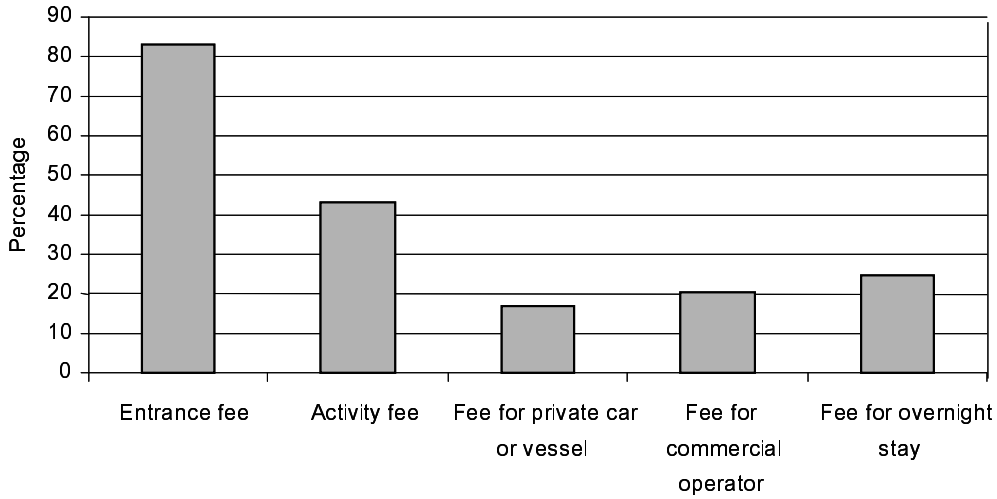

Figure 7.2 Types of fee used in researched parks

The different user fees are described in this paragraph in more detail.

Entrance fee

Visitors pay a fee to enter the park. The fee is paid to visit the MPA for a fixed period, which can be per day, monthly or annually.

The most common charged entrance fees are a uniform fee, the two-tiered fee and the multi-tiered system. In this paper a uniform fee is a fixed fee; every visitor has to pay the same fee in comparison to the other two systems. The two-tiered system charges a different fee for a foreigner and a resident. The multi-tiered system allows different fee for different kind of visitors; the fee is based on different pricing for age, location or occupancy (students, researchers, etc). See the paragraph 'Pricing' for more information.

Figure 7.3 shows the type of entry fee used by the 53 researched parks, 44 parks charged an entrance fee. Note however that some of the parks that use a multi-tiered system also use a two-tiered system.

Other possible entrance fees are for example a fee charged to enter more then one park, e.g. this could be used to visit the Grotto (Bird Island), Laulau Bau and Managaha Island. Bonaire National Marine Park (BNMP) is an example of an MPA that has already implemented a similar concept. Scuba divers buy a special tag for $25 per year, which will give them access to the BNMP and to Washington-Slagbaai National Park.

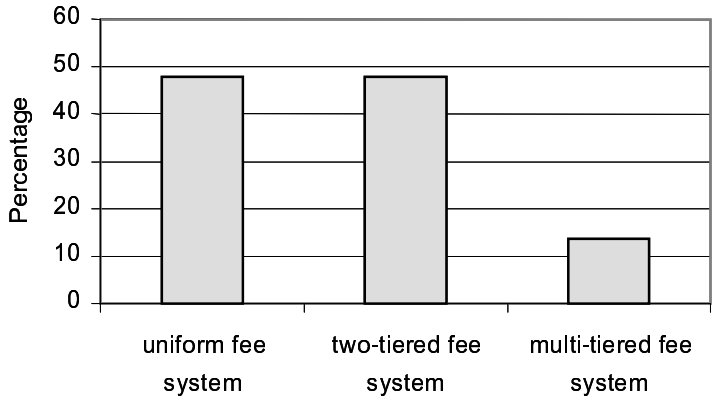

Figure 7.3 Percentage of parks that charge an entrance fee

Another fee is the so-called passport fee, which is used by the United States National Park Service (NPS). This fee is paid by visitors who then can benefit from a high priority visitor service and participate in resource management projects throughout the park. Another form of user fee is a fee that increases per day, so the fee becomes an instrument to control the amount of visitors and thereby the pressure on the coastal ecosystem.

The entrance fee can be adjusted to seasonal fluctuations (in other words to demand) but none of the investigated parks operate a fee this way.

Fee for activities

Another type of user fee is to charge the visitor a fee for the activity the visitor executes in the MPA. The fees that are administered most often are for diving and snorkeling activities. Other activities for which fees can be charged are kayaking, fishing, vessel launching, shooting films or photographs, participating in an educational program or a

fee for the use of the beach or pool. For Saipan one could also think of charging a fee for reef watching with a glass bottom boat.

Figure 7.4 shows the percentage of different type of activity fees used in the researched parks. Note however that one park can use more then one type of activity fee.

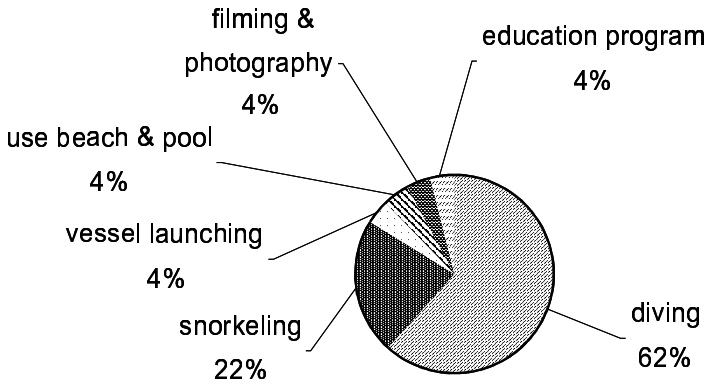

Figure 7.4 Percentage of parks that charged a fee per activity

Fee for use of private vessel or car

Fees are charged for the use of a private vessel or the use of one's own car. In this research the fees charged for the use of moorings and yachts are integrated in the private vessel fee. Figure 7.5 shows of the 9 parks that charge a fee for the use of a vehicle, 78% charge a fee for the use of a private vessel and 22% for the use of their car. Note however that the fee for the use of a private vessel stands out because most of the nature parks included are marine parks.

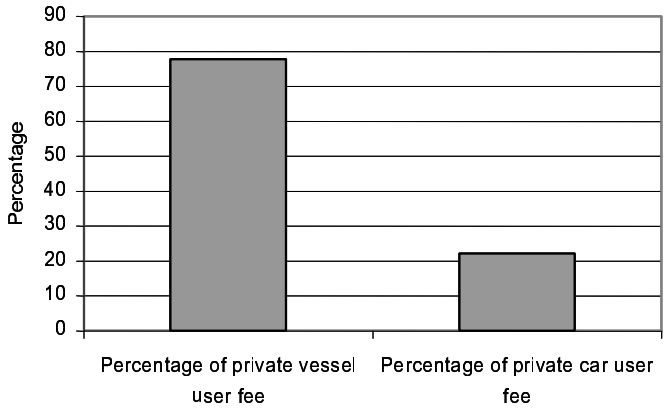

Figure 7.5 Fee for the use of a private vehicle

Fee for commercial operators

Another option is to charge a commercial operator with a user fee instead of the individual visitor. 21% of the researched parks operate such a fee. Different types of commercial operator fees are fees for the activity provided by the commercial operator, such as kayaking, diving, snorkeling, boat trip and or bus/ car rides. Figure 7.6 shows the spread of fee charged to commercial operators.

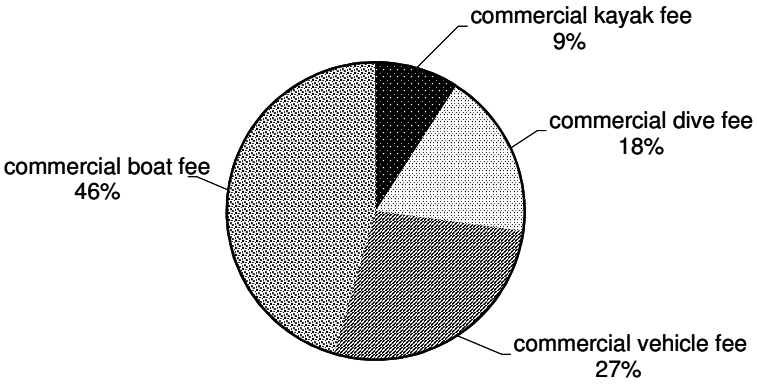

Figure 7.6 Percentage of different fee used for commercial operators

Fee for overnight stay

The fee charged for an overnight stay is depending on the facilities that the MPA has to offer. For example the Vermont State Park (US) charges fees for camping, for the use of cabins or cottages and for the use of lodges. They also charge a reservation fee. Vermont State Park (US) operates two different camping fees, one for the camping with luxury facilities and one for more primitive camping.

Pricing

Setting a fee is a difficult task; by defining a price the attempt is made to quantify the value of a protected area. One of the problems is that there is no competitive market and the economic value of a protected area is therefore estimated and not a given fact. It is hard for the manager to determine how much a consumer should pay for its use (Ibrahim and Cordes 1993). The fee price should be based on visitor demand for access to the protected area. One of the instruments used to calculate the fee price on visitor demand is to calculate the willingness to pay. Note however in general the price elasticity of parks and recreation is high because of the easy substitutability between tourist attractions (Lindberg 1991). Therefore a price which is too high can reduce the number of visitors.

According to Walsh (1986) the demand for recreation services is dependant on the socioeconomic characteristics of the consumer and the attractiveness of the park in comparison to other attractions, as well as the availability of a substitutable service. Other key factors include the travel time to the site, the time a visitor spends in the area , the congestion at the park and the preference of the consumer.

Fee prices can be based on several methods. Brown (2001) distinguishes four types of pricing, namely marginal cost pricing, comparable pricing, multi-tiered pricing and differential pricing. These types are described in more detail:

Marginal cost pricing

Marginal cost pricing is set where the added costs equal the added benefits of producing the park; prices set at the intersection of the marginal cost and marginal benefit curve. Cost recovery is generally the most important guideline for pricing strategies and is the most logical and economically defensible scheme (Walsh 1986). The incremental cost of each additional user is the critical amount when setting appropriate fees (Binkley and

Mendelsohn 1987). Marginal costs are based on the costs of administration, operations, degradation incurred with one additional user. When fees are set where variable costs equal willingness to pay, additional funds will still be needed to cover the total costs of the facility, because in this case it is unlikely to generate enough revenue to cover the total costs (Binkley and Mendelsohn 1987).

A survey by Brademas and Readnour of 372 chief executive officers of public leisure service agencies showed that 40% of the interviewed park managers based their fees on "some overhead" and 36 % said "direct costs only" (Binkley & Mendelsohn 1987).

Comparable pricing

Comparable pricing is based on the average of user fees charged by other parks for equivalent attractions or services. Therefore the different user fees raised by 53 nature parks around the world are researched (See appendix Vfor the parks that are included in the research). The most common fee levels used are 1 $ to 10 $ per day. The range of entry fee varies from 0.20 $ at the Bali Barat MP (Indonesia) to 105 $ for a entrance fee to the Cocos Island (Costa Rica). Our research shows that the average entrance fee charged is around 6 $ if the extremes (such as 100 $ for the Galapagos Islands) are not taken into account (N= 37) (See Table 7.1). According to Lindberg *et al.* (2001) those prices vary depending on the quality and service of the park and the willingness of visitors to pay.

Table 7.1 shows the fees charged around the world according to region. The fees vary from 1.57 $ in the Pacific to the average fee of 9.13 $ in Central America. The extreme fees charged such as 105 $ at Cocos Island, 100 $ at Galapagos National Park and 50 $ at Tubbataha in Philippines are not included in the research.

Table 7.1 Fee price per region

Region	Average entrance fee per day per visitor[1]
Africa	$5.50
Asia	$3.61[2]
Caribbean	$6.33
Central America	$9.13[3]
Pacific	$1.57
South America	$3.75°

[1] Average calculated from available user fee data found through desk research
[2] Excluding 50 $ entrance fee at Tubbataha (Philippines)
[3] Excluding 105 $ fee per trip at Cocos Islands
° Excluding 100 $ entrance fee at Galapagos National Park

Multi-tiered pricing

Multi-tiered pricing is a pricing method based on a different fee for the different kind of visitors, such as residents, seniors, students or researchers. One form of multi-tiered pricing is two-tiered pricing; a different fee for foreign visitors and residents. Two-tiered pricing schemes have been found to yield more revenue than a high or low fee alone (Laarman and Gregersen 1996).

The two-tiered pricing system used at the parks show that the fee charged to foreign visitors lies above the 9 $ and the fee charged to residents lies above the 3 $ (extremes are not taken into account, N=13) (See Table 7.2).

Table 7.2 Average fee price and multi-tiered pricing fee

Entry fee per day	Average price per visitor per day	Multi-tiered pricing per visitor per day
Foreign visitor	Between 5 $ - 6 $	Between 9 $ - 10 $
Resident	Between 5 $ - 6 $	Between 3 $ - 4 $

Source: Cesar and Beukering (2004), Brown (2001) and Lindberg and Halpenny (2001).

Differential pricing

Differential pricing is based on the level of service offered. Differential fees used in a set of campgrounds (luxury and primitive campgrounds)in Vermont resulted in a more even distribution of campsite use and a small increase in total revenue, therefore they could be used as a potential effectively set of management tools (Manning *et al.* 1984).

Another feature that has to be decided upon is the period for which the entrance fee is valid, such as a fee price per day, for a week or annual. The most occurring fee is the fee per visitor per day, but it should depend on the preference and behavior of the target group (e.g. kind of visitors). For example at Bunaken National Park, North Sulawesi, Indonesia there was little interest among residents for a year pass; while in contrast the dive operators viewed daily passes as a hassle for their international clients on vacation.

In general the most beneficial fee system would include fee levels that take into account the operational costs of the protected area and the willingness to pay of protected area visitors (Brown 2001). Protected area management based on consumer demand and costs of supplying the commodity is the most logical and economically defensible method.

Reduction in visitors by entrance fee

The extent to which visitors are discouraged to visit the MPA due to the introduction of a user fee depends on several factors. These include the quality of the site, the availability of substitutes, the extent of the fee price or price increase, and the income of visitors. Sites that have close substitutes will be more affected by a price increase than sites without good substitutes[32]. Sites with more local use than foreigner use are also likely to affected more heavily by price increases: locals generally have lower income and are more price sensitive. Moreover, local are more aware of potential substitutes (Lindberg *et al.* 2001). According to Brown (2001) fees set between $10-20 may not reduce demand for foreign visitors who have travelled great distances and spent substantial amounts of money to get to the park. However is the Saipan visitor coming to this island for its marine parks? In the tourist exit surveys 11% to 22% of the visitors mentioned that their motivation to come to Saipan was the beautiful beaches and sea, and/or the ability to perform marine sports and/or scuba diving[33].

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[32] The Garapan District attracts most visitors and will probably be a good substitute.

[33] From the Korean tourist exit survey, October 2003, the Japanese tourist exit survey, July and August 2003, the Saipan college student tourist exit survey and the CEEC tourist exit survey.

Moreover it is important to look at the price sensitivity of the foreign tourists, especially the Korean and Japanese market, and for future tourism the Chinese market has to be taken into account as well. The price elasticity for visiting the MPAs needs to be established. However, even in cases where the elasticity of demand is relatively high, raising user fees can still result in a net revenue gain. For example, if the elasticity of demand was a five percent reduction in visitors per additional dollar of user fees, and assuming roughly 250,000 visit the Managaha Island MPA in an average year, raising the Managaha Island MPA user fee from $5 to $10 would increase revenues from $1,250,000 to $1,875,000 while reducing tourist numbers (and hence, to some extent, environmental damage) from 250,000 to 187,500. An important caveat is that user fee revenue is not necessarily a measure of the total benefit of visitors, as visitors pay costs in addition to user fees. The loss of income for tour operators, vendors, and others who benefit from visitors would have to be taken into account in determining the acceptable decrease in the number of visitors due to user fee introduction.

More specific research in Hawaii executed by Van Beukering and Cesar. (2004) showed that divers and snorkelers are prepared to pay a certain amount in addition to the usual expenses, to fund a program for a healthier marine environment. 75% of the divers and snorkelers answered that they would pay extra for conservation of the reef. The most frequently answered amount to pay extra for conservation is $5 per experience, however divers have a slightly (i.e. 8%) higher willingness to pay than snorkelers. The breakdown of conservation willingness by nationality resulted in 79% of the U.S. Mainland, 63% of the Japanese visitors and 80% of the visitors from other Asian countries were willing to pay an additional amount. The research concluded that the uniqueness of the site, the service level and the health of the reef have a positive impact on the willingness to pay for conservation. Moreover a regression analysis showed that the level of willingness to pay is positively related with the level of yearly household income of the visitors.

7.7 Applications on Saipan

This paragraph describes the possible cost benefit analysis that could be made for Saipan and furthermore discusses the scores on the indicators for sustainable financing mentioned as presented in Section 7.5. It should be mentioned that lack of information resulted in an incomplete overview.

Cost Benefit Analysis

Coral reef ecosystems generate a wide range of goods and services that benefit Saipan society. However, over-exploitation of these goods and services can lead to threats (such as degradation of the coral), thereby destroying the flow of benefits. Therefore coral reef management is needed. The quantification of benefits and costs of management requires thorough research, including field (market) surveys, benefit transfers, literature reviews and expert judgment. In order to calculate, for example, the recreational benefits, actual expenditures of visitors to the MPA sites need to be determined. We need to calculate the welfare gain of the visitors by measuring their consumer surplus, the actual expenditure directly related to snorkeling or diving experience, other activities directly related to the MPAs and the expenditures indirectly related to the marine experience such as hotel costs and travel costs. Moreover, information about coral habitats and the

varying degrees of economic activity and reef uses is needed (Van Beukering and Cesar, 2004). Such detailed assessment of the consumers preferences was beyond the scope of this study. Therefore, we will use available literature and secondary data to be able to say something about the economic feasibility of MPAs on Saipan.

To give insight in the economic feasibility and desirability of investments in conservation of marine ecosystems it is recommendable to perform a cost benefit analysis (CBA). The investment from a society perspective is desirable, in case the net benefits exceed the net costs to society. Three potential CBAs have been considered on Saipan.

1. A gross CBA in which the budget (or costs) of the enforcement program is compared to the economic value of the coral reef. This CBA option shows that the economic benefits of coral reefs on Saipan are likely to exceed the costs incurred to manage the reefs in a sustainable manner.
2. The second CBA could investigate the benefits of the implementation of additional safety measures and awareness raising among the divers community.
3. The third CBA to be discussed is the economic feasibility to expand the user fee system on Saipan.

Lack of information prevents us from executing one of the three mentioned CBAs in this report. Future research may account for these scenarios, as soon as the required information comes available.

Indicator scores

In the previous sections, indicators for a sustainable finance strategy of MPAs have been presented. In this Section, we will provide an overview for the three MPA dive sites on how they score for the different indicators. The indicator scores are based on information retrieved from secondary sources, such as the Internet as well as primary sources such as agency officials.

Financial indicator[34]

The Marianas Public Lands Authority (MPLA) receives money from the Mañagaha and User Fee Trust Account to employ two full-time Managaha rangers, who collect the landing fees for Mañagaha Island. A commercial tour operator, Tasi Tours, holds the sole concession to operate a business on the Mañagaha Island. The Division of Fish and Wildlife (DFW), the Coastal Resource Management Office (CRMO), and the Division of Environmental Quality (DEQ) receive both local and U.S. federal funding to manage, protect, monitor, and conserve the coastal zone and coral reef environments associated with Mañagaha Island and the other MPA sites. Local action strategies, developed as part of the U.S. Coral Reef Initiative, address both the short and long-term needs of the coral reef resources in the CNMI.

The Division of Fish and Wildlife, which has sole authority over the management of Mañagaha Island and other marine conservation areas (P.L. 12-12), developed a comprehensive management plan for the Mañagaha Marine Conservation Area in 2005. Implementation of that management plan has begun. Full implementation of the actions and activities described in the management plan willl require an investment of $1,641,000, and the plan describes DFW as the direct or indirect source of the necessary funds. The management plan cites Special Use Permits and Commercial Service Permits as a possible source of those funds.

The Managaha Land User Fee Trust Account lacks independence from national economic, political and natural conditions. The revenue generated by the landing fees is claimed by several institutions, and there is no little fund retention for Managaha Island or any of the other MPA sites. In early 2005 the amount available in the fund was $913,332.

However, as shown in Table 7.3, more than $900,000 was appropriated in early March for a number of non-MPA related expenditures including the construction of a head start center and the creation of public sculptures, leading to complaints by local citizens to the Saipan Tribune that the MPLA would be unable to pay the salaries of Managaha rangers (Local Law #14-17; Local Law #14-17; Donato 2005). Additionally, a bill signed in September 2005 appropriated a further $800,000 for promotional activities on the part of the Marianas Visitors Authority and $100,000 for Carolinian and Related Language Assistance project (Saipan Tribune, 2005).

Given that there were approximately 220,000 foreign visitors to Managaha in 2005, according to Tasi Tours (Tilley 2005), the maximum possible revenue from the $5 user fee would be around $1,095,110. As $1,800,000 was appropriated in 2005 for expenditures unrelated to natural resource management, it is unclear where these additional funds came from. It is clear, however, that none of the revenue from the $5 user fee was used for MPA management and enforcement, or for natural resource management of any kind.

Table 7.3 MPLA User fees appropriations

Expenditures	Amount	Share
Headstart Center	$200,000	12%
Canoe House Construction	$100,000	6%
Youth Indigenous Program	$50,000	3%
Public Sculptures	$50,000	3%
Typhoon Reimbursement	$200,000	12%
Youth Center	$300,000	18%
Remaining funds	$13,332	1%
MVA Promotional activities	$800,000	47%
Total funds available	$913,332	

[34] Although there is a management plan, no information has been made available about the existence of a business plan for Managaha Island, Laolao Bay and the Grotto. Therefore, there is limited insight in the sources of financing of the MMA beyond that provided by the Management Plan for the Mañagaha Marine Conservation Area (2005).

DFW, CRMO, and DEQ have a variety of sources of funding for their natural resource management programs. A majority of the activities are funded through the United States Coral Reef Initiative (USCRI) grant administered by the National Oceanic and Atmospheric Administration (NOAA). The CNMI also receives funds, such as those associated with the Sport fish Restoration Program, from the Department of the Interior All of these funds support a wide variety of projects ranging from control of non-point pollution to public education and outreach.

Legal indicators

The legislation of Saipan allows for the necessary money transfers. The MPLA office uses its general funds to carry out the mandate provided under Section 2 of Public Law 11-64 to collect a $5-landing fee from 'each non-resident passenger who disembarks on Managaha island'. There is the law (P.L. 11-64) that authorized the Department of Finance to establish the Mañagaha trust account. Although DFW has the authority to promulgate regulations (P.L. 2-51) for the MPA sites, there are currently no regulations in place, with the exception of the Laolao Bay Sea Cucumber Reserve and the Lighthouse Reef Trochus Reserve, which were established by regulation, not public law. As the first step in the implementation of the Mañagaha Marine Conservation Area Management Plan, DFW has begun the drafting of regulations for this site, which are expected to be in effect during early 2006. Until those regulations are promulgated, the site is protected by legislation. The Mañagaha Marine Conservation Area is defined as a no-take zone with fines between $500 to $10,000 (Public Law #12-12). Mañagaha Island is also protected by the Commonwealth Constitution; article 12, Section 2 states that the island shall be maintained as an uninhabited island and used only for cultural and recreational purposes. The Grotto is protected through the Bird Island Wildlife Conservation Area (Public Law #12-83) and is defined as a No Take Zone with fines between the $100 to $5000. The portion of the dive site, which lies outside of the geographic feature known as "the Grotto" is also protected as a no-take zone through Public Law 12-46, which establishes the Bird Island and the Forbidden Island Marine Sanctuaries. The Laolao Bay site lies within the Laolao Bay Sea Cucumber Reserve (Part V, DFW Non-Commercial Fishing Regulations, via PL #2-51). This area is technically a Limited Take Zone with fines between the $100 to $5000, however in practice it does not have any higher level of protection than any marine waters in the CNMI as it only prohibits the harvest of Sea Cucumber, and there is currently a CNMI-wide prohibition on the harvest of Sea Cucumber in effect. Conservation officers of the Division of Fish and Wildlife regularly patrol the islands to enforce the fish and wildlife laws and regulations. DFW employs three federally funded Marine Conservation Officers who are tasked specifically with patrolling the island's MPAs. Although it is possible for violators to be fined up to $10,000 or to serve up to a year in jail, typical punitive actions are much closer to the minimum fines of $100-$500.

Administrative indicators

The Division of Fish and Wildlife has "the exclusive authority to manage marine conservation areas" (PL #12-12), including the Mañagaha Marine Conservation Area. However, all three natural resource management agencies, DFW, CRM and DEQ, have

authority to manage and regulate activities that take place within the boundaries of the Mañagaha Marine Conservation Area. Monies from locally and federally funded programs is indirectly invested into the management, enforcement, and monitoring of the MMCA and other sites, while none of the revenue of the MPLA landing fees is reinvested in the MPA or any natural resource management activities. Many other parties, however, claim a budget from the Managaha Land User Fee Trust Account (See previous Section "Financial indicator"). According to the MPLA, a newly enacted law and House local bill appropriating money from the fund, would leave the Marianas Public Lands Authority without enough funds to continue employing full-time Managaha rangers. As a result of MPLA landing fees not being reinvested into the management of the park, there has not been much significant progress, beyond the development of a site management plan, in the overall management of the site, which DFW is tasked with. There is no control on the number of visitors to the three MPAs, and it is not known what the carrying capacity of these sites is. The Marianas Visitors Authority (MVA) has hired a security agency to patrol the parking areas at Lau Lau Bay, Obyan Beach and Grotto site. It should be noted that these security guards were hired to deter car break-ins and to count numbers of visitors; they do not have authority to enforce DFW rules and regulations. $75,000 was reserved from the Managaha Land User Fee Trust Account for the hiring of a full-time security guard at that site.

Social and cultural indicators

Not all local communities consider the financing structure as a benefit for their development. The Carolinian people remain opposed to any attempts to further develop the Marine Conservation Area. They regard Mañagaha as a sacred place where their ancestors worshiped their gods and buried their dead. Another indicator is whether a portion of the revenues are assigned to local development, which is the case such as a budget for the Carolinian and Related Language Assistance project. Local people also receive education and training when they participate in volunteer programs and other environmental projects. At Lau Lau Bay, a volunteer monitoring program called the Lau Lau Bay Watershed Watch encompasses different ongoing projects, such as reef-flat monitoring, watershed mapping, stream sampling, and community outreach. An island-wide outreach program promoting the protection and enhancement of coral reef health is also currently being developed, though the funds for this and other natural resource management projects has come from sources other than the MPLA landing fees.

Political indicators

It is not clear if the government supports the introduction of the proposed financing mechanisms. However, there is flexibility in the renovation of policies and legislation to adapt to new finance strategies, such as the newly enacted law House Bill 14/538 to appropriate money from the Mañagaha Land User Fee Trust Account. It seems that the current financing mechanisms are depending on governmental measures. Therefore, we conclude that the financial mechanism is sensitive to political changes.

Environmental indicators

Several authorities are responsible for the conservation and protection of marine and coastal resources in Saipan, such as DFW, CRMO, and DEQ. Each of these agencies

conducts monitoring at sites around the island, and some of those sites are within the MPAs. Data is available on trends over time at these monitoring sites, and trends vary based on the site and type of data being collected. However, the Mañagaha Island landing fee is not earmarked for investment in these agencies whose responsibilities include the conservation and protection of the MPAs. Recently, however, $268,000 was invested in the Grotto site for the construction of a pavilion, walkways, restrooms, picnic tables and an improved drain system.

7.8 Possible user fee options for Saipan

A number of possible options exist for expanding the user fee system in MPAs on Saipan. However, the effectiveness of such an expansion is directly dependent on the proper use of revenues raised in the sustainable management of the MPAs. The current $5 user fee for foreign visitors to Managaha Island is a perfect example of the pitfalls of the politicization of user fee revenues. While the Managaha User Fee Trust raises something on the order of $1 million a year, little of that money actually goes to the management and enforcement needs of Managaha or any of the other MPAs. Rather, the vast majority of revenues raised go to diverse projects ranging from a headstart program, public statues, and hurricane relief for fishermen, etc. While all of these are certainly laudable projects, they should be ideally funded through general government funds and not revenues raised through user fees, as user fees should, in principal, be used to finance the sustainable management of the resource rather than as a general fundraising tool for the government. Visitors are much more likely to be willing to pay user fees when they are informed that their money will be directly used for reef conservation.

As revenues of the Managaha User Fee Trust are currently allocated to a variety of projects, redirecting more than a fraction of existing revenue toward MPA management and enforcement budgets would be helpful but probably politically unfeasible. A more viable strategy would be to impose additional user fees, in Managaha and/or in other sites, with revenues raised specifically earmarked for MPA system funding.

In deciding the optimal user fee system for Saipan, a number of factors need to be taken into account. Specifically, a decision is need on the type of user fee(s) to implement, the locations in which the fee(s) should be implemented, and the level of the fee(s).

Type of User Fees

Possible types of user fees vary widely, with some being more effective or politically acceptable than others. In particular, enforcement costs need taken into account when deciding what type of fee to implement, lest the costs of fee application consume an unacceptably large portion of revenue.

On Saipan, the two most viable user fee options are a direct on-site entry fee (similar to the current user fee on Managaha) and a diver pass system. The direct on-site fee would be fairly easy to implement, as most of the MPAs are accessible only through a single entry-point. Setting up a stand next to the parking lot to charge a fee to all visitors would require the full-time employment of people to collect the fee in all locations in which fees were established. While increasing the current Managaha user fee would have little to no additional enforcement cost, as fees are already collected from foreign visitors,

setting up additional user fee systems at locations like Bird Island (the Grotto) or Laolao Bay would probably incur significant annual labor and administrative costs.

The second option, which may be more effective for taxing the use of reef locations outside of Managaha, is a diver pass system modeled off the successful program established on the island of Bonaire. In this system, visitors to the island are required to purchase a "dive pass" through their dive or tour operator. In Bonaire, these passes are also available for purchase in most hotels and from a central location on the island. Dive and tour operators are required to purchase dive tokens from the government, and are sold to visitors for a set price ($25 in Bonaire). The dive pass system has the benefit of outsourcing administrative costs to dive and tour operators, so implementation costs are rather low for the government. As all dive operators (ideally) report the number of clients and revenue earned for tax purposes, it would be easy for the government to determine how many dive tokens are being sold and prevent operators from reselling the same tokens multiple times. This system has the benefit of efficiently allocating fees to those users who have the most impact on the reef.

The pitfalls of charging fees via dive and tour operators are threefold:

- Dive operators may have an incentive to under-report client numbers to reduce costs, and voluntary reporting by dive operators is the only practical low-cost method of obtaining user numbers.
- Charging user fees through dive operators may prove politically unpopular, as dive operators will likely oppose the plan and express concern about its effects on client numbers. In practice, however, visitors coming to the island intending to dive will be unlikely to be deterred any more by a user fee internalized in the activity cost than by an entry user fee.

Location of User Fees

Managaha Island would probably be the easiest location to implement a site-specific user fee increase with revenue earmarked for MPA management. As the infrastructure for fee collection is already in place, implementation and enforcement costs would be relatively minor. Additionally, given the high visitor volume, a relatively small increase in the user fee could generate a significant amount of revenue. The user fee increase in Managaha could apply either to all visitors or specifically to those intending to dive.

As the Grotto, part of the Bird Island MPA, is a popular dive site with a significant number of divers concentrated in a small area, it would be another good location for a user fee to be implemented. In the case of a direct on-site entry fee, it would make sense to only charge visitors intending to dive, as visitors at the location for other purposes are unlikely to have any significant impact on the reef.

Laolao Bay, another popular dive site and one of the most ecologically damaged reef areas on the island, is another location where user fees could potentially be considered. A direct on-site user fee applying to all users would work well for this location.

A Bonaire-style dive pass system, in contrast, would probably apply to all locations on the island rather than just the MPA sites. Users purchasing a pass would be allowed unlimited dive trips although, as in Bonaire, dive passes should probably only be valid for a year.

Level of User Fees and Elasticity of Demand

User fees are, in part, economic mechanisms that internalize the environmental externalities caused in an area by certain activities into the market price of visiting that area or undertaking those activities. As such, the optimal level for user fees should be based on the expected marginal damage that each individual causes through their use of the coral ecosystem resources. As this marginal social cost is rather difficult to measure, and many of the drivers of ecosystem degradation are difficult to correlate with an individual visit (i.e. nutrient loading due to hotel water purification or increased sewage runoff), the actual level of the tax is best determined by analyzing both the costs of management and the willingness to pay of visitors for conservation.

In a number of empirical studies in other MPAs around the world, the introduction of user fees has had no significant effect on visitor numbers. At the 12 sites in appendix VII of this report where data is available on the effects of user fees on visitor numbers, only three experienced a reduction in visitors after fee introduction, often in cases where user fees were charged to locals as well as tourists. For the purposes of calculating revenue and visitation effects of different user fees options on Saipan, we will assume the elasticity of demand to be defined by the function shown in Figure 7.7, reflecting the non-linear nature of demand elasticity with increasing fees.[35]

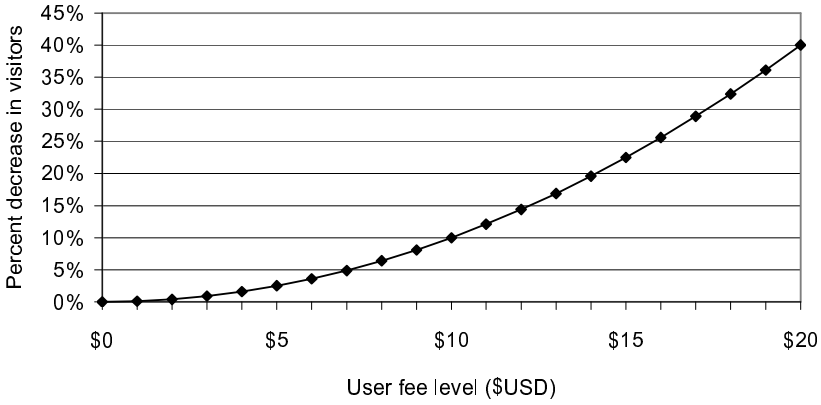

Figure 7.7 Percent decrease in visitors per dollar increase in user fee

7.9 Concluding remark

This Chapter examined various aspects of revenue generation for MPAs in general, especially for coral reef areas with examples from around the globe. Successful application of the described financial instruments depends on the specific characteristics of an MPA. Also, it is not necessary to put to practice all financial instruments to achieve sustainability. However, it is important to have a diverse portfolio that covers both short and long-term needs. On the other hand, having in place different mechanisms does not guarantee the sustainability of the financial strategy; other aspects like legal, social, environmental and political issues should also be taken into consideration.

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[35] This function is an rough approximation, as no thorough willingness to pay surveys have as of yet been conducted in Saipan.

Governments need to recognize and accept that conservation and national development are inextricably linked. Governments should bear the ultimate responsibility for managing protected areas since they are national assets and provide benefits to the nation as a whole. They need both to remove and redirect funding for perverse subsidies to increase the financial flows to environmentally sustainable activities in general and to protected areas in particular. Policy considerations should include provisions that make it easier for protected areas to generate more funding necessary for them and government leaders would require further knowledge of the functioning of stock market and investments. Luckily, governments are increasingly cooperating with NGOs, the private sector and local communities to finance protected areas. They must also create favorable conditions for such partnerships to emerge and flourish, without compromising their ultimate responsibility to safeguard their countries' protected areas (Quintela et al. 2003).

8. Conclusions and recommendations

8.1 Introduction

Saipan's beautiful fringing and barrier coral reefs are scattered along the 68 km coastline. Providing a habitat for rare wildlife such as green and hawksbill sea turtles and dolphins, as well as being an ecosystem in which 256 species of coral have been identified, the coastal ecosystem of Saipan preserves a unique habitat for marine life (Randall, 1995; Rogers et al., 2002). The economic importance of this ecosystem is also significant. Besides providing food, shelter and cultural significance for the citizens on Saipan, the coral reefs generate revenue from tourists and recreational users attracted by the beauty of the coral and its inhabitants.

However, various environmental impacts degrade the valuable coral reefs. Direct threats include crown of thorn outbreaks, coral diseases, coral bleaching, and typhoons. Human activities, such as scuba diving, anchoring, fishing and marine recreational sports (e.g. jet skiing) can directly damage the reefs of Saipan, if not properly managed. In addition, the recovery of the reefs is potentially hampered because of the pollution and the intensive coastal development at Saipan, leading to land based pollution and sedimentation (Wilkinson, C. 2004).

In September 2003, several authorities of the CNMI prepared the "Three-Year Coral Reef Protection Local Action Strategy (LAS)", in which several projects focused on developing a sustainable long-term marine use program. As an integral part of, the LAS, this study aimed at increasing the understanding of the economic importance of such management interventions.

The main objective of the study was to carry out an economic valuation of the coral reefs and associated resources on Saipan. The focus is on valuing the six main uses/users of selected coral reef areas on Saipan that jointly make up the Total Economic Value (TEV): (i) fisheries; (ii) recreational uses (iii) tourism uses; (iv) shoreline protection; (v) amenity values; and (vi) biodiversity. In addition, the spatial variation of the TEV across the various coral reefs on Saipan is determined and the issue of sustainable financing is discussed with the idea of capturing the TEV in actual financial flows.

8.2 Policy recommendations

Several types of information need to be available, in order to provide economically sound guidance to decision makers on the management of coral reefs:

- On *economic values*: To what extent do the various economic sectors benefit from the goods and services provided by coral reefs on Saipan? And, within the 72 square kilometer 'coral reef zone' along Saipan's coastline, which reefs play the most important role in the provision of these benefits?
- On *threats*: What are the main threats to coral reefs on Saipan? What are the origins of these threats and which reefs do they affect most?
- On *management interventions*: Which measures should be taken to prevent further degradation of coral reefs on Saipan, and what financial costs are involved?

- On *financial mechanisms*: Which funds can be accessed to finance the management of coral reefs on Saipan? Can novel (market-based) instruments be used to generate sustainable funds for management?

If all this information were available, one could subsequently: (1) identify both the most valuable, and most seriously threatened, reefs on Saipan, (2) determine the type of threat jeopardizing a specific reef and select a number of potentially worthwhile interventions, (3) evaluate the economic benefits and financial costs associated with these interventions, while simultaneously (4) finding sustainable sources of funding for management interventions.

Clearly, the means available during this study were insufficient to complete all four steps listed above. This study carried out step 1, and partly step 2. At the same time, some knowledge was generated to support step 3 and 4, but still substantial gaps in information and knowledge remain. Fortunately, Saipan's Local Action Strategy (LAS) gives a good idea of the type of management interventions planned. By combining the LAS (2003) and the findings of the valuation study, several specific policy recommendations can be provided.

Recommendation 1: Tackle the problem of non-point and point source pollution:

The general public is thoroughly aware of the impact of point and non-point source pollution on the state of the marine environment on Saipan, and expects the CNMI government to solve this problem. In fact, citizens even have clear ideas on how to address these problems. Moreover, from the perspective of the Total Economic Value, reducing water pollution seems to be cost effective. Many of these sites that in recent years experienced microbiological violations were within the highly developed Garapan district. Garapan has one of the most valuable reefs on Saipan, and therefore pollution problems in this district need to be solved immediately. Similarly, Laolao Bay can be considered a prime attraction for divers and snorkelers and therefore also deserves special attention in reducing sedimentation in the near shore waters. The violation of local water quality standards by the two sewage outfalls also requires immediate action.

Recommendation 2: Make use of the cultural importance residents place on marine ecosystems to improve coral reef management

Lack of education about coral reef issues has been repeatedly noted as a problem facing marine conservation in the CNMI. The survey and choice experiment, however, revealed a strong link between local residents and their marine ecosystems. Most residents are concerned about the state of the marine environment and favor stringent measures geared towards its protection. Water pollution followed by stormwater runoff causing sedimentation are their greatest concerns. These concerns can be used to create increased local support for coral reef management. Residents are also a potential source of funding, since a significant share of respondents indicated they would be willing to pay higher taxes for improved marine management. At the same time, launching campaigns on the importance of coral reefs for Saipan could further enhance residents' bond with reefs. Good examples of public campaigns are the education programs by the DFW on endangered species issues, the erected signage at entrances to the Bird and Forbidden Island by the DLNR, and the education program on Non-Point Source pollution and coral reef water quality issues by DEQ.

Recommendation 3: Develop a system of user fees for visitors of the Marine Protected Areas on Saipan

We expect that user fees for visiting the most popular MPAs on Saipan can easily be implemented (or expanded) without notably affecting the popularity of these unique tourist attractions. As long as the user fee is within a reasonable range (i.e. between $1 to $10 per visit), tourists do not experience the additional cost as unfair, especially because the fee is in line with the polluter pays principle. A pre-requisite, however, is that collected funds will be effectively re-invested in the conservation of the MPAs on Saipan, as well as the provision of improved facilities at the site. The collected revenues could, for example, be used to educate visitors to the MPAs about the "do's" and "don'ts" of snorkelers and divers (i.e. the education model applied in Hanauma Bay, Hawaii). Another useful measure to be funded through the collection of user fees is the improved enforcement of existing legislation. However, the user fees should not be collected as a additional source of revenue for government spending in general. If user-fee revenues are transferred to the treasury without safeguarding the integrity of the MPAs, visitors may on the long term be discouraged to visit these degrading attractions.

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Appendix I. Overall questionnaire

I. Name Interviewer:		*IV. Name data enterer:*	
II. Date of interview:		*V. Date of data entry:*	
III. Location of interview:		*VI. ID number:*	

QUESTIONNAIRE SAIPAN

Introduction – Refer to the instructions in the interview protocol (Section 1 – Introduction)

I. Fish diet

1. How often does your family eat fish/seafood? We eat fish/seafood… (*check one box*)

a. Every Day	b. Every 2 days	c. Twice a week	d. Once a week	e. Every 2 weeks	f. Once a month	g. Once in 2 months	h. Never
□	□	□	□	□	□	□	□

If the answer to Q1 is 'h', never, skip to Q6

2. Please indicate the main sources of the fish/seafood you consume (percentage-wise)

Source	*Fill share (Should add up to 100%)*
1. Fish caught by myself or someone in my immediate family	
2. Fish caught by an extended family member (e.g. uncle) or friend	
3. Purchase it from the road side	
4. Purchase it a flea market	
5. Purchase it at a store/restaurant	
6. Other, specify …	

3. In general, where does the fish/seafood you consume come from (where is it caught)?

	Please fill share *(Should add up to 100%)*
1. Reef fish and other species from inside Saipan's reef	
2. Fish caught outside Saipan's reefs (e.g. deep water, pelagic)	
3. Imported fish/seafood from the mainland (e.g. canned from US)	
4. Imported fish/seafood from other pacific islands (e.g. Chuuk)	

4. Did your family's fish/seafood diet change over the last 10 years? (*check one box only*)

a. Eat much less fish	b. Eat some-what less fish	c. No change (*skip to Q6*)	d. Eat some-what more fish	e. Eat much more fish	f. Don't know
□	□	□	□	□	□

If the answer to Q4 is "c. no change", skip to Q6.

5. Can you indicate the 1st most, 2nd, 3rd and 4th most important reason why your family's diet of fish/seafood had changed? *(You may also check less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. We fish less/more	□	□	□	□
2. We fish the same amount but catch less/more	□	□	□	□
3. There is less/more sharing of fish between family, friends, etc.	□	□	□	□
4. Change to other food (e.g. spam)	□	□	□	□
5. The price of fish has decreased/increased	□	□	□	□
6. Availability of certain local species changed	□	□	□	□
7. Scared of ciguatera /polluted fish	□	□	□	□
8. Preference for fish has changed (don't like fish as much)	□	□	□	□
9. Other, specify …	□	□	□	□
10. Don't know	□			

II. Recreation

6. Please indicate who in your immediate family above 8 years of age can swim? (*Check all options that apply*)

a. Respondent	b. Spouse	c. All children	d. Some children	e. No children	f. Nobody
□	□	□	□	□	□

7. How often does anyone in your household participate in each of the following activities?

	a. Every week	b. Twice a week	c. Once a month	d. Once in two month	e. ±4 times a year	f. Once a year	g. Never
1. Beach picnic/BBQ	□	□	□	□	□	□	□
2. Swimming	□	□	□	□	□	□	□
3. Kayaking/paddling	□	□	□	□	□	□	□
4. Jet skiing	□	□	□	□	□	□	□
5. Snorkelling	□	□	□	□	□	□	□
6. Scuba diving	□	□	□	□	□	□	□
7. Fishing	□	□	□	□	□	□	□
8. Body boarding/ surfing	□	□	□	□	□	□	□
9. Windsurfing/ kite-boarding	□	□	□	□	□	□	□

8. For your household, what are the 1st, 2nd, 3rd and 4th most important conditions for recreation? *(You may also tick less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. Good public facilities (e.g. BBQ, restroom)	□	□	□	□
2. Plenty of parking space	□	□	□	□
3. Clean and wide beach	□	□	□	□
4. Clean and clear waters (unpolluted, visibility)	□	□	□	□
5. Healthy coral reefs	□	□	□	□
6. Abundant fish stock	□	□	□	□
7. Safe and calm waters	□	□	□	□
8. Proximity to home	□	□	□	□
9. Other, specify …	□	□	□	□

III. Environmental awareness

9. In your opinion, how has the quality of the following components of the marine environment in Saipan changed during your lifetime:

	a. Increased significantly	b. Increased somewhat	c. Remained stable	d. Decreased somewhat	e. Decreased significantly	f. Don't know
1. Live coral abundance	□	□	□	□	□	□
2. Fish abundance	□	□	□	□	□	□
3. Fish size	□	□	□	□	□	□
4. Fish species diversity	□	□	□	□	□	□
5. Algae growth	□	□	□	□	□	□
6. Sedimentation	□	□	□	□	□	□
7. Water pollution	□	□	□	□	□	□

If respondent did not perceive any change in the marine environment (e.g. answered 'c' or 'f' for all features in Q9), then skip to Q11.

10. What do you think are the 1st, 2nd, 3rd and 4th most important causes of the change in quality of the marine environment in Saipan. *(You may also check less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. Sedimentation due to intentionally set fires	☐	☐	☐	☐
2. Sedimentation due to poor development practices	☐	☐	☐	☐
3. Increased runoff and storm water	☐	☐	☐	☐
4. Increased pesticides/fertiliser from golf courses and hotels	☐	☐	☐	☐
5. Leakage from broken sewage pipes	☐	☐	☐	☐
6. Use of improper fishing techniques (walk & collect from the reef)	☐	☐	☐	☐
7. Too many fishermen	☐	☐	☐	☐
8. Too many jet ski's, banana boats	☐	☐	☐	☐
9. Too many divers and snorkelers	☐	☐	☐	☐
10. Other, specify …	☐	☐	☐	☐
11. Don't know	☐			

IV. Fishing

11. Does anyone in your household currently fish?

(Important Note - fishing can include any method of harvesting marine food from the sea including hook and line, spearing, netting, trapping, gathering shellfish/octopus/sea cucumber at low tide, etc).

a. Yes	b. No
☐	☐

If the answer to Q.11 is "Yes", ask if the person in the household who most often actively fishes can help answer the supplemental fishing survey. If the answer to Q.11 is "No", skip to section VII – Choice Experiment

(If applicable, break here to complete the supplemental fishing survey)

VII. Choice experiment

!!!!CRITICAL!!!!

Record the survey version that you are using (e.g. Green2)

12. Choice Set Version: _____

Part I – Introduction to the Attributes

!Refer to the Interview Protocol! (SECTION 2 – CHOICE EXPERIMENT)

Part II – Choice Questions

13. Record the respondent's answers to each choice question in the table below. *(Check only one box in each row).*

Choice set	Option 1	Option 2	Current Situation	Refused the question
Choice Set 1 – Common Set	☐	☐	☐	☐
Choice Set 2 –	☐	☐	☐	☐
Choice Set 3 –	☐	☐	☐	☐
Choice Set 4 –	☐	☐	☐	☐
Choice Set 5 –	☐	☐	☐	☐

If the respondent chose the "Current situation" 3 or more times OR refused to answer any of the choice questions, then ask question 14, otherwise skip to question 15.

14. In the last 5 questions, you <<*Insert appropriate phrase here…*chose the 'current situation' option at least 3 times *OR* refused to answer some (all) of the questions>>. Please tell me why you answered in this way.

1. The people who are doing the damage should pay to protect the reefs not me	☐	8. The reefs are part of our culture and traditions. We should have free and unrestricted access to them	☐
2. I am not confident that the money will be used as specified…government is too corrupt	☐	9. Other activities are more damaging to the reefs than the ones described in the questions…questions unfairly targeted one group	☐
3. It's too late anyway. There is not much that we can do about it now.	☐	10. I couldn't understand the questions…too hard to make the choices	☐
4. I was not convinced that the options were realistic	☐	11. The choices weren't relevant to me. Didn't describe what matters to me	☐
5. The issues are more complex than these questions suggest	☐	12. Other, specify…	☐
6. The costs were too high	☐	13. Other, specify …	☐
7. Don't need another tax no matter what it is used for	☐	14. Don't know/refused	☐

VI. Reef Management

15. Imagine that you are the governor of Saipan and that you are in the position to do something about the management of the reef fish and corals in Saipan. Please indicate the 1st, 2nd, 3rd and 4th most important measures that you would take to improve the marine environment in Saipan. *(You may also check less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. Outlaw the intentional setting of fires that cause sedimentation	☐	☐	☐	☐
2. Set and enforce stricter rules on development	☐	☐	☐	☐
3. Prohibit jet-skies in areas where they can damage the reefs	☐	☐	☐	☐
4. Reduce pesticides/fertiliser use at golf courses and hotels	☐	☐	☐	☐
5. Improve the sewage system (e.g. repair/extend sewage pipe)	☐	☐	☐	☐
6. Expand the marine protected areas	☐	☐	☐	☐
7. Prohibit walking and collecting invertebrates from shallow reef	☐	☐	☐	☐
8. Introduce a user fee for foreign scuba divers and snorkelers	☐	☐	☐	☐
9. Limit human use to popular sites (i.e. divers, snorkelers)	☐	☐	☐	☐
10. Increase the penalties for violators of existing laws	☐	☐	☐	☐
11. Open the marine protected areas certain periods of the year	☐	☐	☐	☐
12. Educate children and general public about marine ecosystem	☐	☐	☐	☐
13. Better enforce existing laws	☐	☐	☐	☐
14. Other, specify …	☐	☐	☐	☐
15. Nothing. Things are fine the way they are	☐			
16. Don't know	☐			

VI. Demographics

The remaining questions are for statistical purposes.

16. Where were you born? (*Tick only one*)

1. Saipan/Rota/Tinian	☐	9. Korea	☐
2. Palau	☐	10. Japan	☐
3. Guam	☐	11. Hawaii	☐
4. Yap	☐	12. Mainland US	☐
5. Chuuk	☐	13. Philippines	☐
6. Pohnpei	☐	14. Elsewhere, specify …	☐
7. Kosrae	☐	15. Don't know/refused	☐
8. China	☐		

17. If you are not born in Saipan, when did you arrive in Saipan? (*fill only one cell*)

1. Please fill year of arrival in Saipan	……	*2. Born in Saipan*	☐

18. What is your ethnic background? I consider myself … (*If relevant, check **more** than one*)

1. Chamorro	☐	8. Pohnpeian	☐
2. Filipino	☐	9. Palauan	☐
3. Carolinian	☐	10. Chinese	☐
4. Korean	☐	11. Japanese	☐
5. Yapese	☐	12. Hawaiian	☐
6. Kosraen	☐	13. Caucasian	☐
7. Chuukese	☐	14. Other, specify …	☐

19. How much longer do you intend to stay in Saipan?

1. Forever / rest my life	☐	4. Around another 5 years	☐
2. Around another 25 years	☐	5. Around another 1 years	☐
3. Around another 10 years	☐	6. Don't Know/Refused	☐

20. What is your profession? (*Check only one*)

1. Management, professional etc.	☐	7. Government	☐
2. Service & tourism	☐	8. Military	☐
3. Sales and office	☐	9. Student	☐
4. Farming, fishing forestry	☐	10. I am unemployed	☐
5. Construction, transport & maintenance	☐	11. I am retired	☐
6. US Government (non military)	☐	12. Other, specify	☐

21. Please fill in the age and sex of yourself and your immediate family members.

	Sex	Age		Sex	Age
1. Respondent			7. Fifth child		
2. Spouse			8. Sixth child		
3. Oldest child			9. Seventh child		
4. Second child			10. More children, fill total	# …..	
5. Third child			11. Other, specify …		
6. Fourth child			12. Other, specify …		

22. What is the highest level of education you have completed?

1. Elementary school	☐	4. Finished college (bachelor's degree)	☐
2. High school	☐	5. Advanced degree	☐
3. Some college or university	☐	6. Don't know/refused	☐

23. Please tell me about your total household (gross) income from all sources last year.

1. $5,000 or less	☐	6. $35,000 to $50,000	☐
2. $5,000 to $10,000	☐	7. $50,000 to $75,000	☐
3. $10,000 to $20,000	☐	8. Over $75,000	☐
4. $20,000 to $35,000	☐	9. Prefer not to answer	☐

24. If you have any other comments, please leave them in the box below.

If you want to be informed about the final results of this study, please leave us your contact information below.

Name (optional): _____

Phone (optional): _____

E-mail (optional): _____

THANK YOU VERY MUCH FOR PARTICIPATING IN OUR SURVEY!

If you have any questions or concerns about this survey, please contact John Gourley (Micronesian Environmental Services) Ph: 322-7289

Please note that your personal information will not be linked to your survey responses. Published information will be in summary form only. We will not use your contact information for purposes other than contacting you about the results of the survey. In addition, we will not trade, sell or otherwise provide your personal information to any other party.

Appendix II. Fishery questionnaire

Saipan Coral Reef Household Survey – Supplement, Fishing survey

To be filled out by interviewer:

I. Name Interviewer:		*IV. Name data enterer:*	
II. Date of interview:		*V. Date of data entry:*	
III. Location of interview:		*VI. ID number:*	

Start here…

Important Note – for this survey, fishing refers to any form of harvesting marine food from the sea including hook and line, spearing, netting, trapping, gathering shellfish/octopus/sea cucumber at low tide, etc.

1. How often do you fish? Once every … (*check only one box*)

a. Day	b. 2 or 3 days	c. Week	d. 2 weeks	e. Month	f. 2 Months	g. 6 Months	h. Year	i. Never
☐	☐	☐	☐	☐	☐	☐	☐	☐

2. On average, how much time is spent actively fishing per trip? (*check only one box*)

a. 0-2 hours	b. 2-4 hours	c. 4-6 hours	d. 6-8 hours	e. 8-12 hours	f. 12-18 hours	g. >18 hours
☐	☐	☐	☐	☐	☐	☐

3. Can you indicate 1st most, 2nd, 3rd and 4th most important reasons why you go fishing?

(You may also check less than 4 boxes)	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. I really enjoy fishing	☐	☐	☐	☐
2. I really need the fish to feed my family	☐	☐	☐	☐
3. Giving catch to family, friends, and others strengthens social bonds; sharing is part of our culture.	☐	☐	☐	☐
4. I really need the money from the fish I sell	☐	☐	☐	☐
5. Tradition: My family has always fished. Fishing is my life!	☐	☐	☐	☐
6. Fishing strengthens the bond with my fellow fishermen	☐	☐	☐	☐
7. Fishing strengthens the bond with my children/family	☐	☐	☐	☐
8. I go fishing especially for mañahak, ti'ao, and e'e during seasonal runs	☐	☐	☐	☐
9. I go fishing to catch fish for fiestas/parties	☐	☐	☐	☐
10. Other, specify …	☐	☐	☐	☐
11. Don't know	☐	☐	☐	☐

4. How many years have you been fishing on Saipan?

a. less than 2 years	b. 2 to 5 years	c. 6 to 9 years	d. 10 years or more
☐	☐	☐	☐

Answer Q5 only if you have been fishing on Saipan for 10 years or more.

5. 10 years ago, how often did you go fishing on Saipan? Once every… (*check only one box*)

a. Day	b. 2 or 3 days	c. Week	d. 2 weeks	e. Month	f. 2 Months	g. 6 Months	h. Year	i. Never
☐	☐	☐	☐	☐	☐	☐	☐	☐

Answer Q6 only if your fishing behavior has changed over time (e.g. you fish more or less often)

6. Why has your fishing behaviour changed over time? Please indicate the 1st most, 2nd, 3rd and 4th most important reasons. *(You may also check less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. Because I grew older	☐	☐	☐	☐
2. Because I have less/more time than before to go fishing	☐	☐	☐	☐
3. Because the need for fish for my family has changed	☐	☐	☐	☐
4. Because the need for additional income from fishing has changed	☐	☐	☐	☐
5. Because fish availability has changed (quantity and size)	☐	☐	☐	☐
6. Because the cost of fishing has changed (fuel, gear, etc)	☐	☐	☐	☐
7. Because my family changed their fish diet	☐	☐	☐	☐
8. Because I only started fishing recently	☐	☐	☐	☐
9. Other, specify …	☐	☐	☐	☐
10. Don't know	☐			

7. Please indicate your average monthly expenses on fishing related items.

Cost category	*Please fill amount (US$/month)*
1. Fuel & oil	
2. Ice	
3. Bait (i.e. fresh)	
4. Fishing Equipment (e.g. nets, lures, lines, and hooks)	
5. Other, specify …	
6. Don't know	☐

8. What are the 1st most, 2nd, 3rd and 4th most important fishing techniques that you use? *(You may also check less than 4 boxes)*

	a. 1st most important	b. 2nd most important	c. 3rd most important	c. 4th most important
1. Bottom: hook & line (less than 100ft)	☐	☐	☐	☐
2. Bottom: hook & line (more than 100ft)	☐	☐	☐	☐
3. Trolling	☐	☐	☐	☐
4. Cast net (Talaya)	☐	☐	☐	☐
5. Drag and surround net (Chenchulu)	☐	☐	☐	☐
6. Snorkel spear fishing during daytime	☐	☐	☐	☐
7. Snorkel spear fishing at night	☐	☐	☐	☐
8. Foraging the reef (shell, crabs, etc)	☐	☐	☐	☐
9. Trapping (octopus, crabs, etc.)	☐	☐	☐	☐
10. Other techniques, specify …	☐	☐	☐	☐

9. How often do you encounter people using illegal fishing practices (for example, scuba spear fishing, gillnetting, dynamite, chlorine, fishing in marine reserves, etc.) or find evidence that people have recently used illegal practices in an area? … (*check one box only*)

a. Regularly	b. Occasionally	c. Rarely	d. Never
☐	☐	☐	☐

10. On average, how much fish/seafood does you catch on a monthly basis?

Please fill average amount:	……	*Pounds per month*

11. What percentage of your average monthly catch is made of each of the following types of fish? (Distribute catch percentage-wise across the different types of fish)

Type of catch	*Percentage (must add up to 100%)*
1. Reef fish	
2. Reef invertebrates such as octopus, shellfish, crab, etc)	
3. Shallow bottom fish (less than 100 ft)	
4. Deep bottom fish (more than 100 ft)	
5. Pelagic fish	
6. Other, specify….	

12. Several options for distributing your household's catch are listed below. Please indicate how your catch is normally divided up (i.e. percentage-wise).

Options for distributions	*Fill share (must add up to 100%)*
1. Consumption by my immediate family	
2. Distribute it among my extended family and friends	
3. Sell it to fish shop	
4. Sell it elsewhere (i.e. restaurants)	
5. Other, specify …	

13. On average, how much cash income does your household receive on a monthly basis from selling fish?

Please fill average amount:	……..	*US$ per month*

14. Do you own a boat? … (*check one box only*)

a. Unmotorized	b. Motorized (<15hp)	c. Motorized (>15hp)	d. No boat
□	□	□	□

Thank you very much

Appendix III. Exit survey

To be filled by operator	Name Interviewer:	Questionnaire
Date (m/d/y):	Flight number: ..... to City:	code #:
The survey is only for foreign tourists, check this, if people come only conference/business, please ignore!!!!		

TOURIST EXIT SURVEY FOR SAIPAN/TINIAN/ROTA

We hope you enjoyed your holiday in Saipan/Tinian/Rota. We need your help to learn more about how you spent your holiday here. We're not selling anything; we're interested in your opinions. Everything you tell us is 100% anonymous. We hope you are willing to participate in this survey.

Q1. What is your gender? Male____ Female____

Q2. Are you married or single? Married___ Single ___

Q3. What is your age? _____ years.

Q4a. Is this your first trip to Saipan, Tinian or Rota? Yes_ No_ (If Yes, skip to question 5)

Q4b. How many times have you visited our Commonwealth (including this trip)? ___times.

Q5. What motivated you to travel to Saipan, Tinian or Rota? (Please check (√) all that apply)

1 □ A previous visit
2 □ Price of the tour package
3 □ To visit friends or relatives
4 □ Recommendation of friend/relative/travel agent
5 □ Scuba diving
6 □ Water sports (snorkeling, windsurfing, etc.)
7 □ Short travel time
8 □ To golf
9 □ Just to relax/pleasure
10 □ My company sponsored me
11 □ It is a safe place to spend a vacation
12 □ Beautiful seas, beaches, tropical climate
13 □ Shopping
14 □ Special Promotion
15 □ To Get Married/Attend Wedding
16 □ Honeymoon
17 □ Organized Sporting Activity
18 □ Other (Please Specify: _____)

Q6. Who are your traveling companions? (Please check (√) all those that apply).

1 □ I am traveling alone (Skip to Question 7)
2 □ With only my Spouse (Skip to Question 7)
3 □ With Family
4 □ With other siblings/extended family
5 □ With older parents
6 □ With Friends
7 □ With Office Colleagues
8 □ With Others (Please specify: _____)

Q7. Please describe your travel arrangements to Saipan, Tinian and Rota?

1 □ Full package tours (airfare, hotel, meals, optional tours included)
2 □ Free-time package tours (airfare and hotel only)
3 □ Individually Arranged Travel (Free Independent Traveler)
4 □ Group tour
5 □ Other (Please specify: (_____)

Q8. How many night(s) did you stay in Saipan, Tinian and Rota together ? _____ Night(s)

Q9. Of your stay in Saipan, Tinian and Rota, how many nights did you stay in:

1 □ Saipan _____Night(s)
2 □ Rota _____Night(s)
3 □ Tinian _____Night(s)
4 □ Other _____Night(s) Please specify where: (_____)

To understand your total trip expenditures, we need to ask you about prepaid expenses as well as your expenses during your stay on Saipan, Tinian and Rota.

Q10a. First, some questions regarding how much you spent for your trip to Saipan, Tinian and Rota. If you were responsible for paying for others beside yourself, please indicate the total number of people included in these expenditure estimates. To begin with, how much did you pay in your own country before coming to Saipan, Tinian or Rota for the tour package(s), or your airfare and lodging?

US$ _____ (If you paid nothing for your trip, record a zero and skip to question 11a.)

(* with translations, please use yen, korean and chinese currency etc.)

Q 10b. How many people were included in your prepaid expenditure estimate? _____People.

Next, we need to ask you about your expenses during your stay in Saipan, Tinian and Rota?

Q 11a. How much in total did you spend while in Saipan, Tinian and Rota during this trip? (Exclude any expenditures made in your own country.): US$_____ (Total on-island expenses).

Q11b. Counting yourself, how many people are included in your on-island expenditure estimates? If the reported figures are only for you, please record "1" in the space below; (if the total also includes others, record the exact number of people included in your on-island expenditure estimates): _____People.

Q11c. Next, please separate your total on-island expenses into the labeled categories below. Report all on-island expenditures in US Dollars (all forms of payment). If nothing was spent in a category, record zero ("0") in the space provided. Please make sure you total all expenses in the space provided below. The total should equal the sum of all categories.

AMOUNT ($ US Dollars)

$_____1) Food & Beverages (in hotel; restaurant and elsewhere)
$_____2) Optional Tours/Activities
$_____3) Gifts/Souvenirs (for yourself and/or others)
$_____4) Local Transportation
$_____5) Hotel/Accommodation (if not already paid for in your own country)
$_____6) Other Expenses Not Covered Above
$_____7) Total On-Island Expenditure

Q12. How many optional (paid and ticketed) tours did you participate in during this visit to Saipan, Tinian and Rota? _____Optional tours.

Q13. Could you please tell us which activities and (optional) tours you have participated in during your visit to Saipan, Tinian and Rota? (Please check (√) all those that apply).

a. □ Island tour	h. □ Water skiing	o. □ Dolphin Watching
b. □ Casino	i. □ Sky-diving	p. □ Parasailing
c. □ Tinian day trip	j. □ PIC Day Tour	q. □ Snorkeling
d. □ Rota day trip	k. □ SCUBA diving	r. □ Glass Bottom Boat
e. □ Managaha Island	l. □ ("Sirena") Submarine	s. □ Jet Skiing
f. □ Fishing	m. □ Seawalker	t. □ Other water sports (banana boat,etc.)
g. □ Dinner cruise	n. □ Beach Resorts	u. □ Other (Specify .....)

Q14. For three sites on Saipan, we are very interested to know whether you have visited these sites or participated in any activity there. (Please check (√) all those that apply).

a. □ Managaha Island	b. □ the Grotto	c. □ LauLau

Finally, we would like to ask a few more questions about you.

Q15. What is your approximate annual personal income, before taxes?
(please change currencies depending on translation)

1 □ Less than US$ 20,000
2 □ US$ 20,000 - US$ 29,999
3 □ US$ 30,000 - US$ 39,999
4 □ US$ 40,000 - US$ 49,999
5 □ US$ 50,000 - US$ 69,999
6 □ US$ 60,000 - US$ 99,999
7 □ more than US$ 100,000
8 □ No Income

Q16. Where do you live?

1 □ Japan
2 □ Korea
3 □ US mainland / Hawaii
4 □ Guam / Micronesia
5 □ Taiwan
6 □ Peoples Republic of China
7 □ Hong Kong
8 □ Other (Please Specify: _____)

THANK YOU. THIS IS THE END OF THE SURVEY. PLEASE RETURN THIS QUESTIONNAIRE TO THE INTERVIEWER AND WAIT UNTIL HE/SHE HAS FINISHED REVIEWING YOUR ANSWERS.

Appendix IV. Principles of choice modeling

The theoretical basis for stated choice research lies in random utility theory in which a person's utility from a particular site or experience is described by the following utility function (sometimes referred to as a conditional indirect utility function):

$$U_{in} = V_{in} + \varepsilon_{in} . \quad (1)$$

The utility gained by person *n* from alternative *i* is made up of an objective or deterministic and observable component (*V*) and a random, unobservable component (ε) (Adamowicz *et al.*, 1994, 1998).

The observable component of utility (*V*) can be expanded as follows:

$$V_{in} = \mathrm{ASC}_i + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k . \quad (2)$$

ASC_i is an alternative-specific constant which represents the "mean effect of the unobserved factors in the error terms for each alternative" (Blamey*et al.* 1999, p. 341). The X_k values are associated with each attribute level used in the choice experiment, while the β_k coefficients are included to capture the corresponding part-worth utility associated with each attribute level for all *k* attributes.

An individual will choose alternative *i* over alternative *j* if and only if the total utility associated with alternative *i* is greater than alternative *j* or $U_{in} > U_{jn}$. The probability that person *n* will choose alternative *i* over alternative *j* is given by the equation:

$$\mathrm{Prob}(i|C) = \mathrm{Prob}\{V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}; \forall j \in C\}, \quad (3)$$

where *C* is the complete set of all possible options from which the individual can choose.

The unobservable component ε, often referred to as a random error component, is commonly assumed to be type I or Gumbel distributed and to be independently and identically distributed (McFadden 1974).

If the ε term is assumed to be Gumbel-distributed, the probability of choosing alternative *i* can be calculated by the equation (McFadden 1974):

$$\mathrm{Prob}(i) = \frac{\exp^{\mu v_i}}{\sum_{j \in C} \exp^{\mu v_j}}, \quad (4)$$

which represents the standard form of the multinomial logit model (MNL).

Although the MNL is the most common form applied to the analysis of discrete choice data due to its robustness and simplicity associated with calculating the probabilities (Louviere *et al.* 2000), other models are also regularly used in stated choice research (e.g. the probit model). An important outcome of the logit model is that choices are assumed to be independent of irrelevant alternatives (IIA), meaning that "the ratio of choice probability for any two alternatives is unaffected by addition or deletion of alternatives" (Carson *et al.* 1994, p. 354). In other words, the alternatives are assumed to be independent.

The β_k coefficients (or part-worth utilities) are derived by fitting the choice model to the observed data on the stated choice probabilities (aggregated over all respondents) and the experimental design used to define the attribute levels seen by respondents for each choice set. Choice models are usually estimated using maximum likelihood analysis.

To calculate efficient part worth utilities, the choice experiments are normally designed to ensure orthogonality[36] of attribute levels both within and between alternatives. A full factorial design where all main effects and interactions are orthogonal represents one extreme. However, full factorial design plans require individuals to evaluate an unrealistic number of choice sets (e.g. every possible combination of attribute levels), even in cases where the total number of attributes is small. Therefore, researchers typically make trade-offs between the ability of a design plan to estimate all possible interactions and the necessity of limit evaluation to a reasonable number of choice sets by employing a fractional factorial design plan. Fractional factorial designs typically permit the orthogonal estimation of all main effects and at least some interactions between the attributes.

[36] In an orthogonal design, the attribute levels are uncorrelated with any other attributes, thus ensuring that the part worth utilities measure only the intended attribute and are not confounded with other attributes.

Appendix V. Evidence on the spillover function of MPAs

This Appendix is taken from Friedlander and Cesar (2004)

Because of the generally poor state of fisheries worldwide, marine resource managers are inspired to consider fresh tools to stem the decline in global fish stocks (FAO 1999). Marine ecosystems are complex with highly variable natural replenishment and therefore require more spatially-based management tools. The Food and Agriculture Organization (FAO) has established a code of conduct that supports the precautionary principle, which states should apply to conservation, management, and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment (FAO1995). It states that the 'absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.'

Theoretical evidence has been available for decades on policies that scale back fishing rates when abundance drops. One means for achieving a constant escapement-like policy is the use of marine reserves to protect part of the stock (Figure V.1). What reserves offer that other management tools cannot is the ability to control fishing rates in a manner that is relatively easy to enforce (PDT 1990; Sladek Nowlis and Friedlander, 2004a) and requires relatively little scientific information (Sladek Nowlis and Bollermann 2002). In addition, reserves prevent habitat disturbance due to fishing, protect non-target organisms, and preserve biodiversity (Bohnsack 1996, Murray et al. 1999, Fogarty et al. 2000). This Appendix, we will refer to these reserves as Marine Protected Areas (MPAs) as is common in the fisheries literature. In the accompanying papers of this study, we will refer more broadly to Marine Managed Areas (MMAs) to highlight that these areas tend to have other management aspects than conservation and fisheries, such as tourism.

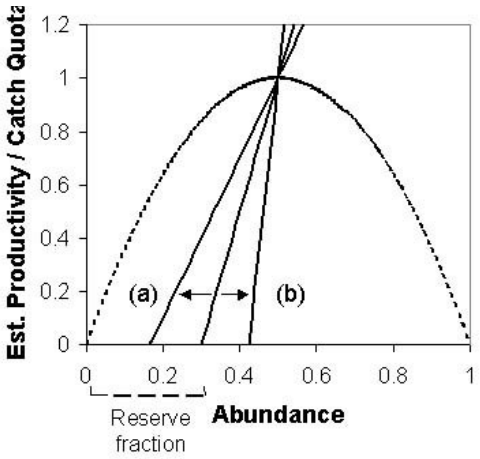

Figure V.9.1 Marine reserves as a tool to achieve constant escapement. The dotted line represents estimated productivity, and the solid lines represent policies that link marine reserves with catch quotas. The centerline represents the use of a reserve encompassing 30% of the unfished stock biomass and fairly aggressive fishing on the remaining stock. Line (a) represents a relatively smaller reserve, with a more-controlled fishing effort but less insurance, while line (b) represents a larger reserve and even more aggressive fishing pressure and greater insurance. The optimal policy will depend primarily on the degree to which the biology, ecology, current abundance, and fishing mortality rate of the stock or stocks are unknown, and thus amount of insurance that is desirable or necessary (from Sladek Nowlis and Bollermann, 2002).

Benefits of MPAs are:

- Increase stock abundance - Theory supports the ability of marine reserves to rebuild overfished fisheries and enhances catches (Beverton and Holt 1957; DeMartini 1993; Polacheck 1990; Sladek Nowlis and Roberts 1999) and several empirical studies have shown increased catch despite 25% to 40% reserve closures (McClanahan and Kaunda-Arara 1996, Russ and Alcala 1999, Roberts et al. 2001). Catch around Apo Island in the Philippines has increased since the early 1980's despite the closure of more than 10% of the fishing area (Russ and Alcala 1999, Figure V.2). In contrast, Sumilon Island (25% no-take reserve), also in the Philippines, showed a decline in catch following the opening of the reserve to fishing. Despite the increased fishing area, both total catch and catch per unit effort declined to half of their previous values Subsequent closures showed slight increases in catch but these catches were much smaller than those observed when a complete closure of 25% was in place;
- Preserve desirable traits - Selective fishing can affect a number of population characteristics—size and age composition, sex ratio, genetic make-up, and large-scale behavioral phenomena like spawning aggregations (PDT 1990), while reserves have been shown to preserve these traits;
- Provide spillover of adults and juveniles into fished areas – Movement can serve as a mechanism for exporting productivity from marine reserves to fishing areas. Johnson and colleagues (1999) demonstrated that, in addition to a build-up of biomass within a reserve off Cape Canaveral, Florida, some fish moved in and out of the reserve. Consequently, a number of world record trophy fish were caught in the vicinity of the reserve (Roberts et al. 2001);
- Increase reproductive output and recruitment inside and outside the reserve; - The protection of adult biomass greatly increases reproductive potential (Polacheck 1990; DeMartini 1993; Guenette and Pitcher 1999) and therefore spawning output. Because adult retention and population growth rates provide the engine to power all population-level benefits, leakiness of adults (spillover effect) can have negative consequences to the population (Sladek Nowlis and Roberts 1999). Emerging evidence about fish movement suggests that even fish with the potential to swim long distances might stay in the same area for long periods of time (e.g., Attwood and Bennett 1994; Holland et al. 1996). In support of this notion is the fact that most populations studied in marine reserves responded positively to protection, even though many of the reserves were small (Halpern 2003);
- Insurance against uncertainty - Most fisheries, even those that are actively managed and well studied, are prone to crashing because management reference points have a high likelihood of being off by 50 percent or more (NRC 1998). By protecting a set amount of fish, marine reserves have shown strong potential to protect stocks from collapse in varying and uncertain environments (Lauck et al. 1998; Mangel 1998; Sladek Nowlis and Bollermann 2002);
- Reduce overfishing by controlling fishing mortality (Sladek Nowlis and Bollermann 2002);

- Ecosystem management - By reallocate fishing effort in space and protect populations, habitats, and ecosystems within their borders, marine reserves provide a spatial refuge for the ecological systems they contain (Sladek Nowlis and Friedlander 2004a);
- Maintain system productivity - Destructive fishing practices can disturb habitats essential to fisheries production (Watling and Norse 1998, Morgan and Chuenpagdee 2003). System productivity can also reduce by fishing activity through the disruption of species interactions (Jackson et al. 2001);
- Provide unfished reference areas - distinguish between natural and fishery-related changes in marine systems, dramatically limiting a manager's ability to explain past events and predict future ones.

Appendix VI. Revenue Earning Mechanisms for MPA

Source or Mechanisms	**Definition / Example**	**Who can use it**	**Advantages**	**Constraints**
Government appropriations	Funds appropriated in national budgets for protected area management	National protected areas agencies	-Regular, recurrent income -Compatible with national environmental priorities	-Usually insufficient to meet management needs -Additional funds not usually available -Complex budgeting and accounting rules -Government priorities and budgets can change with political and other changes
Taxes, levies and surcharges	Fees and levies imposed on certain activities, sales or purchases (e.g. tourism tax, bed tax, airport tax, fishing license, diver operator license, etc.)	Government imposes and collects; proceeds may be earmarked (e.g. for protected area budgets, trust funds, etc.)	-Regular, recurrent income -Use generally unrestricted -Can capture economic benefits from resource uses (e.g. tourism, fishing, boating, etc.)	-May require special authorizing legislation -May generate controversy, especially among constituencies to be taxed (requires public education on advantages and purpose of levy) -Can result in negative activities if sole purpose is to raise funds -Goes through central government coffers
Environmental funds	Funds that are created and managed as private non-profit organizations, capitalized by grants from governments and donor agencies, and sometimes receiving income from taxes and fees earmarked for conservation	Government and non-profit organizations	-Provide long-term financing for biodiversity conservation and other environmental activities -Allocates money toward community development activities that demonstrate a positive impact on the conservation of the parks and their diversity; research activities that provide data for improving park management and park/community relations; and park management activities for the protected areas that are not covered under normal government budgets	-Does not pay attention to capacity-building both for the fund management and local institutions -Local stakeholders need to understand how a long-term fund operates -Trustees and government leaders require further knowledge of the workings of the stock market and investments -There is no single environmental fund model that would meet the needs of MPAs across the world
Debt- swaps	Debt-for-nature swaps have been successful in generating long-term funding for conservation. Debt swaps are a method by which debt owed by a developing country can be renegotiated with creditors to fund nature conservation activities. Debtor countries can negotiate debt swaps with creditor governments (bilateral debt) or with the private sector (commercial debt)	Developing country government, commercial banks and international non-profit organizations	-Successful in generating long-term funding for conservation	-Complicated to negotiate and require large investments of time -High-level political support for the financial arrangement is critical -Participation of experts and professionals is also vital, particularly financial and economic specialists -There is the challenge of sustaining, and even increasing, the value of the fund

User fees	Charge for non-consumptive use or visitation (usually 'per person' or 'per vehicle'); may be daily, seasonal or annual, may be charged to tour firms bringing escorted groups	The entity with jurisdiction over a protected area may collect fees itself or designate another party to do so on its behalf, depending on applicable law	-Regular, recurrent income -Use generally unrestricted -Embodies 'user pays' principle -Can be used to regulate access, control over-use, and manage visitation flow among protected areas -Easy to implement in areas with a limited number of access points	-Not appropriate for little-visited areas (projected revenue should exceed cost of collection) -Potential equity issues (can be addressed by lowering fees for national/local residents, etc.) -Introducing fees for areas that previously were free can generate controversy; -Costs involved with collection of fees -Challenges of setting the correct price -After fees are set there is little flexibility to change
Leases and concessions for products and services	Legally binding agreements between the entity with authority over the protected area and private organizations or entrepreneurs who market goods and services related to the protected area and return some share of the profits, or a flat fee	Protected areas agencies, private reserves, NGOs, businesses	-An effective mechanism to provide services with little up-front investment by the protected area -Concessionaire incurs the risks associated with potential non-profitability -Concessionaires bring marketing and business skills to the table -Enables the management agency to focus on resource protection -Provides opportunities for local entrepreneurs	-Concessionaires operate to generate profit, may not share values of protected area and need to be carefully monitored -Estimation of fees is complex and difficult; need to ensure healthy and safe service at reasonable price to visitor; fair return to both protected area and entrepreneur -Not appropriate for little-visited areas
Sale of goods and services	Gift and souvenir shops, sale of items such as maps and guides, fee-for-service tours, anchorage, mooring, equipment rental, camp or picnic space rental, exhibit entry, etc.	Park agencies, NGOs, concessionaires	-Goods and services can do double duty as sources of income and visitor education, promotion -Generally does not require additional legal authorization; easy to keep proceeds within area	-Initial investment required for production of inventory of goods, recruitment of providers of services -Goods and services should be limited to those related to protected area purposes -potential for competition with other local providers of goods and services
Case-related marketing	Sale of mostly intangible items (membership, voluntary add-ons to hotel and restaurant bills, etc.) - primary value is purchaser's knowledge of helping conservation	Most often used by NGOs	-Combines promotion, education and fundraising -In some cases contributions may be tax-deductible -Markets can be easily identified (park visitors, NGO members, etc.) -Involves local business community in protection	-Many areas have no built-in market, must develop visitor logs, etc. -Requires fairly sophisticated understanding of marketing and what will sell, or an experimental approach -Potential for market saturation
Biodiversity prospecting	Contracts in which a pharmaceutical company or other entrepreneur secures right to genetic resources (bio. materials collected and processed for analysis) in return for cash payments and/or royalties on any medicines or products developed	Generally government or international agencies, sometimes private research institutions with consent of appropriate government agencies	-Up-front cost is minimal -Opportunity to train and employ local researchers in collection and initial processing	-Speculative enterprise, impossible to know potential financial return up front -Requires skilled legal representation for contracts -Royalty payments may not be received for decades if at all, depending on the actual value of the resources on the global market

Community-based initiatives	Initiatives such as fishing concessions and sustainable resource use to generate revenue at the local level. The local community interests include the long-term availability of funds for protected areas, and equitable distribution of the financial and non-financial benefits generated by MPAs	Local communities, government, and non-profit organizations	-Involvement of stakeholders	-Complex arrangements of funding -Policy reforms are needed (such as assigning legal recognition to community involvement and traditional practices) -Delegation of authority to the community in order to manage the local resources (therefore investment is needed in capacity-building of local community members and institutions)
Tourism operator certification	The certification of tourism operators provide an incentive for tourism operators to invest in environmentally sustainable operation since consumers undertaking nature-based tourism often seek out certified or recognized destinations	(Local) Governments and tourism operators and tourism institutions	-Incentives for tourism operators to invest in environmentally sustainable operations	-Need an international recognized institution to certify -Marketing effort to raise awareness of those certifications among consumers
Real estate tax surcharges	Governmental agencies can set up special projects that generate money for conservation such as funding of earmarked projects; competitive grants, lotteries, stamps etc.	(Local) Government	-Tax is paid by direct beneficiaries who, in a lot of cases, are affluent -Recurrent funding	-It is/can be a politically controversial option -Legal issue
Special governmental projects	Governmental agencies can set up special projects that generate money for conservation such as funding of earmarked projects; competitive grants, lotteries, stamps etc.	Governments	-Huge potential source of funding, because there is a strong incentive (For example for lottery promoters the incentive is to allocate part of the revenues from lotteries for good public causes)	-Legal issues -Development of the projects can be time and money consuming -No direct or indirect connection between the source of the revenue and the conservation purposes for which the revenue may be spent
Philanthropic foundations	Grant-giving organizations	Generally available only to nonprofit organizations	-Can be a significant source of revenue for specific project activities or start-up of new programs	-Not a source of recurrent funding -Intense competition for limited funding often leads to significant investment of effort in proposals with low-to-medium funding chance
Corporations	Sponsorship or other types of voluntary payments by companies	Park agencies, NGOs	-Generally a means of raising both national and international support for facilities or management -Corporate donors' expectations often can be met with simple acknowledgement placards -means to link companies that benefit from MPA to supporting them (tourism, hospitality industries)	-Often corporations desiring to be sponsors are those with whom the protected area may not wish to be associated (resource exploitation sector) -What corporate sponsors get in return needs to be carefully limited before donations are solicited and accepted.

Individual donations	Gifts by individuals through a variety of mechanisms – direct gifts, memberships, wills, bequests, etc.	Generally NGOs, but sometimes include protected areas agencies	-Potential donors come to you and only need to be asked -No cumbersome application process -Can build donor loyalty over time -Usually unrestricted gifts	-Requires insight into potential givers and what motivates them -Some gifts, especially bequests, may take years to cultivate and eventually realize -Can be a significant source of funds for an MPA
Trust funds	Capitalized through different donor agencies or funding sources and managed and controlled by an independent board of directors	Park agencies, NGOs	-Sustained, long-term funding for MPAs -Can extend the lifespan of a grant -Channel large-scale grants to many small-scale users -Can be set up for different purposes: a single protected-area, an entire protected-area system, a transboundary protected area, small grants to community -Is kept separate from other sources of money (such as government budgets)	-Potentially have high admin costs -May generate low or unpredictable investment returns, esp. in the short term, if investment strategy is not well conceived, or if particularly sharp changes in the markets occur.
Private sector investments	Business planning, venture capital investments, concession arrangements, private sector management of protected areas and voluntary contributions are examples of private sector investments. Private investments are generally a relatively minor source of funding for parks and conservation. There exist also for-profit investments providing financial returns for investors while promoting conservation in a designated environmental zone	Governments and organizations	-Sharing management responsibilities, knowledge and expertise -Greater freedom for park managers in deciding where and how to spend their own limited resources	-Different interests -Loss of control -Legal issues
Fishing industry revenue	Governments can raise revenues to manage fisheries by charging fishing payments, license fees, excise taxes and fines. They can charge levies on the commercial fishing and ask for fishing access payments. The protection of biodiversity contributes also to fish populations and fishing industry benefits from spill-over effect.	Governments and non-profit organizations/ institutions	-Economic incentives for sustainable fishing practices, thereby improving both the environmental and economic conditions of the industry	-Time and money consuming to implement an enforcement mechanism -The awarding of quota's is a disputable activity; it can lead to a concentration of ownership of fishing quotas -Fish quota's can result in unearned windfall profits when the original quota holders sell their quotas

Source: adapted from Morris (2002 and from Nature Conservancy and UNEP (2001)

Appendix VII. User fee in MPAs around the world

Country	Site(s)	Fee and mechanism	Earmarked to park/agency?	Opposition? (by tourism industry unless noted.)	Reduced visitation?
Australia	12 MPAs - managed by national govt	None			
	Great Barrier Reef MP	$2 per day (max. $6)	Yes, but through national treasury	Yes, due in part to lack of advance notice. Led to reduction in fee increase and phased introduction.	
	MPAs and other parks managed by States	Varies. No fee at many sites. $7.50 at Ningaloo MP.	Yes (Tasmania)	Yes, due to lack of advanced notification in past, especially in case of Ningaloo MP (Western Australia).	Yes at some sites with predominantly local use (Tasmania).
Bahamas	Exuma Land and Sea Park	Private vessels: $5/day; Charter vessels: for private charter, dive charter, kayak charter: $1/foot/day. No charge for Bahamian vessels.			
Belize	Hol Chan MP; Half Moon Caye	Hol Chan $2.50; Half Moon Caye $5; Belizeans free	Yes		No
Brazil	Abrolhos Marine NP; Fernando de Noronha MP	$4.25 per day	Yes (to IBAMA, with 50% staying in parks)	Some due to concerns about local access	No
British Virgin Islands		$1 per day + mooring fees Collected primarily by operators, with non-commercial visitors buying directly from the National Parks Trust.			
Costa Rica	Cocos Island	$105 per trip			
	General	$6 for foreigners			
Ecuador	Galapagos NP	$100 for foreigners, $6 for citizens	Yes, 90%		
Egypt	Ras Mohammed	$5 for foreigners; $1.20 for Egyptians	Yes, env'tal fund under Ministry of Env't.	Not usually	No
	Red Sea Marine Park	$2 per day for divers and snorkelers; Sold via operators	Yes, Egyptian Environmental Trust Fund.	Some opposition; Fee initially set at $5 to match Ras MohaMPAd , but industry lobbied to reduce to $2.	Yes, even at $2 caused shift to non-fee areas nearby.
Guam		None			
Honduras	Sandy Bay - West End MR	$1 per dive			

Indonesia	Bali Barat MP	Proposed $0.20		None	
	Bunaken MP	$0.20 locals or day visit; $6.60 per year divers. Tag system, modeled after Bonaire.	80% to park; 10% local govt; 10% national govt	Yes, from local government (distribution of revenue). Industry supportive	No
	Komodo NP	$2.50; increase proposed			
Jamaica	Montego Bay MP	None (fees have been proposed)			
Kenya		$5 for foreigners. $1 for Kenyans	Yes		
Malaysia		$1.30 adults $0.65 children, etc.			
Mexico		Proposed nationally. Currently collected voluntarily at Cozumel MP ($2 per diver, $1 per snorkeler per day).	Yes, for current collection at Cozumel.	Operators set up voluntary system at Cozumel. Opposed to national fees because of effect on visitor numbers and lack of earmarking to parks. Opposition apparently has prevented implementation.	
Micronesia	Truk (Chuuk)	$30 dive tax, $31.50 per week cruising tax for live-aboards (both per person)			
Mozambique	Bazaruto Archipelago	$5	To community projects		
Netherlands Antilles	Bonaire	$10 per year (same for locals and foreigners), tag purchased on resort check-in.	Yes, covers 80% to 90% of park budget.		No – has increased visitation as divers seek well managed reefs.
	Saba	$3 per dive, $3 per week for snorkelers. Residents free. Operators collect and transfer to agency.			No
	St. Eustatius	$12 per year for dive tag; $10 per night for yachts			
Palau	Koror State	$15 per two weeks for divers; collected by operators	Yes, raises $1 million/year, enough to cover all costs.		
Papua New Guinea	Milne Bay	$1 per diver per site for local boats, $3.30 for non-local boats	Paid to communities/ resource owners	Opposed to increases due to lack of advance notification.	No
Philippines	Tubbataha	$50 for foreigners; $25 for Filipinos	Yes, raises $87,500 per year for management		
	Gilutungan Marine Sanctuary	$1 per day for foreigners; $0.50 for Filipinos. Paid by operators.			
Saipan	Marine parks	$1 per day for visitors			
St. Lucia	Soufriere Marine Management Authority	Divers: $4 per day or $12 per year. Snorkelers: $1 per day (commercial operators only). Operators collect these fees, rangers collect yacht fees.		Support has increased due to positive customer feedback	No – numbers have increased.

Suriname	Galibi Nature Reserve	Day visitors: $1 per day. Overnight visitors: included in lodging.		Some initial opposition, but not due to lack of advance notification.	No
Tanzania	Mafia Island	Foreigners: $10 entry, $5 diving per day	Yes		
Thailand	General	Foreigners: $4.40; Thais: $0.40		Yes, due to lack of notification	Yes, amongst foreigners at smaller parks; not amongst organized tours.
Trinidad and Tobago	Tobago Cayes MP	Proposed: $5 for yachts (tickets purchased locally). $2.50 for charters (paid by operators).	Yes	Some, for various reasons, including advance notification.	
Turks and Caicos Islands		None, but parks financed by 1% VAT charge on restaurants and lodging			
United States	Hanauma Bay (HI)	None for Hawaii residents. $3 for non-residents	Yes		
	John Pennekamp Coral Reef State Park (FL)	$5 per visitor per day			
	Channel Islands Natio-nal (Marine) Park (CA)	None			
	Dry Tortugas National Park (FL)	None			
Vietnam	Hon Mun MP	Fee system proposed			
Western Samoa	Palolo Deep Marine Reserve	$0.70			

Notes: (adapted from Lindberg and Halpenny, 2001-a); Blank cells indicate lack of information. All information relates to marine areas unless otherwise noted. Monetary figures are in $ equivalents and are rounded to the nearest 0.10. All fees are per person unless otherwise noted. At sites with multiple fees, some fee details are excluded.